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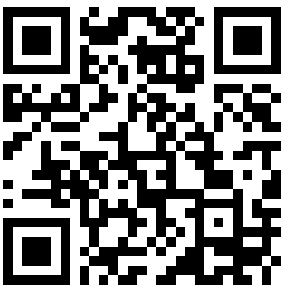

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THE ELECTRICIAN:

A WEEKLY JOURNAL OF

THEORETICAL AND APPLIED ELECTRICITY AND CHEMICAL PHYSICS.

VOLUME VII.

FROM MAY 21 TO NOVEMBER 12, 1881.

LONDON:
Printed and Published by JAMES GRAY, at the Office, 396, Strand, in the City and Liberty of Westminster.

1881.

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THE ELECTRICIAN:

A WEEKLY JOURNAL OF

THEORETICAL AND APPLIED ELECTRICITY AND CHEMICAL PHYSICS.

No. 1.—Vol. VII. SATURDAY, MAY 21, 1881. Price 4d.

SLIP

The Future of the Postal Telegraphs.—We are compelled to leave over an article on this question to our next issue.

Society of Telegraph Engineers and of Electricians.—We understand that the paper to be read and discussed on the 26th inst. will be "On Field Telegraphs in Afghanistan," by P. V. Luke.

Exports.—The exports of telegraphic wires and apparatus from the United Kingdom during the month of April, 1881, were valued at £62,777, as against £48,212 in the same period of 1880, and £20,990 in 1879.

Society of Arts.—On Wednesday last Mr. Alexander Siemens read an excellent paper on the "Electrical Transmission of Power and Electrical Railways," discussion of which was adjourned to Wednesday, the 25th May.

Royal Society.—A paper was presented to this society on Thursday last by Mr. W. Crookes, F.R.S. "On Discontinuous Phosphorescent Spectra in High Vacua," and another by Professor Hughes, F.R.S., on "Molecular Magnetism."

The West Indies.—During the interruption of the cable between Key West (Florida) and Havana messages will be forwarded from the former place by the best available means; there will be no alteration in the rates of messages.

The Shetland Islands.—During the interruption of the cable between the Orkney and Shetland Islands messages will be sent per steamer, which leaves Kirkwall, weather permitting, on Tuesdays and Saturdays, usually about noon. The tariff remains the same.

The Telephone in Australia.—A Mr. W. L. Neale recently gave a lecture on the telephone at Tarlee, South Australia, and is said to have enabled the audience to hear distinctly the Adelaide Post Office chimes at a distance of seventy miles from the lecture room.

The Telegraph in China.—Attention is being directed in Hong Kong to the grave dissatisfaction existing about the combination of the telegraph companies, and the consequent increase of 10 per cent. in the charges, and the making permanent, seemingly, of the high charges and arbitrary rules.

Overhead Wires.—To the other adornments of aerial telegraphy in the City we now notice that cables are being swung across the streets. There are already eight of these suspended high over Cornhill, five of them very thick. They are all the property of private companies, chiefly telephone.

Telephonic Extension.—We understand that the Postal Telegraph Department has arranged for the installation of telephone exchanges at Cardiff, Glasgow, Greenock, Leicester, Newport, Nottingham, Sunderland, and Swansea. This list will, no doubt, be in a short time very considerably extended.

The Brush Light in the City.—The Brush system of electric lighting, extending from Blackfriars to King-street, Cheapside, which broke down last week owing to defective insulation, was started again in the early part of this week, the fault having been remedied. We hope there will be no more breakdowns in the future.

Prices.—The prices this week as quoted are:—For gutta percha, per lb., genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d.; india rubber, per lb., Para, fine, 3s. 6d., negrohead 2s. 5d., central American 1s. 11d. to 2s. 6d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

Cable Grappling.—Last year we noticed the successful grappling and repair of the Porthcurnow-Lisbon cable in 2,000 fathoms. Unfortunately, after a few months another fault was developed, and we have now to announce that this has been successfully picked up and repaired in 1,900 fathoms by the Eastern Company's ss. "Chiltern."

Constancy of the Leclanché Cell.—A correspondent of *L'Electricité* says that he fitted up an electric bell for a retired invalid army colonel, in December, 1876, using three Leclanché cells, and that, with the exception of refreshing each with 25 grammes of ammoniacal salt in 1878, he has not touched them, and that they are working well to this day.

Telegrams for the Transvaal.—We learn that telegrams will be transmitted to Heidelberg, Standerton, and Pretoria, in the Transvaal, by heliograph from Newcastle, Natal. An additional 4d. per word, in addition to the usual charges, will be made for these telegrams. All telegrams for the Transvaal will, however, still be accepted only at the sender's risk.

The Colonies.—A reduction of 4s. 3d. per word on ordinary rates is allowed on Press telegrams (written in plain English and not in cypher, code, or figures) to South Australia, Western Australia, Victoria, and New South Wales, if forwarded per Eastern, Indo-European, and Submarine Companies route, and 5s. 2d. per word if sent by Great Northern Company's route.

The Telephone at Buenos Ayres.—The Gower-Bell telephone has been established in this city, nearly 45 miles of wire having already been laid for telephonic purposes. The President of Uruguay also has a private line from the

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Government Office to his private residence out of town, and speaks with delight of his experiences with the telephone—so says the *Providence* (Rhode Island) *Journal.*

THE FUSION OF IRIDIUM.—A Reuter's telegram of the 13th of May says:—A discovery has been announced before the Cincinnati Scientific Society of a process for fusing and moulding iridium, which has hitherto been deemed impossible. A bar of this metal, which was used as a substitute for the negative carbon in an electric lamp, burned sixty hours without loss of weight or change of form.

COMPETITIVE EXAMINATION.—An open competitive examination for fifty vacancies in the Post Office (male) School of Telegraphy will be held in London on the 7th June. The limits of age are fourteen and eighteen, and the subjects of examination writing from dictation, handwriting, and easy arithmetic. Further particulars can be had on application to the Secretary, Civil Service Commission, Whitehall, S.W.

THE ELECTRIC LIGHT IN SOUTHWARK.—At the last meeting of the St. Saviour's Vestry an application from the Electric Light and Power Generator Company to lay a cable down to enable them to take their lights over Southwark Bridge was referred to the Paving Committee. It was also resolved that this company be treated with to place a light at the junction of Southwark Bridge-road, in Southwark-street, and the Siemens Company for a light at Findlater's-corner.

THE FRENCH TELEGRAPH CLERKS.—A correspondent writes to *L'Electricité* saying that the French clerks have grievances as well as the English, including amongst them pay. He says that the Minister of Posts and Telegraphs has endeavoured to please the public, who were not discontented by lowering the rates. Will he not add a little to the clerks' pay? Under other *régimes* officials are regarded as petty tyrants who oppress the public, under the republic it is otherwise, and the officials are reduced to a state of slavery.

THE TELEPHONE IN ITALY.—We announced in a recent Note that the Italian Government had given permission for the erection of telephone lines in several towns, amongst others, Turin. We now hear that the *Société Générale Italienne des Téléphones* has begun the work of installing a telephonic service. The police, fire stations, railway stations, principal doctors, hotels, theatres, journals, banks, and the Exchange are all to be connected by telephone. Arrangements are also being made for private individuals to have lines to their houses.

A NOVEL USE FOR THE MICROPHONE.—A certain Count Hugo von Engenberg, of Tratzberg, near Hall, in the Tyrol, is making use of microphones, sunk in the ground on the declivity of a hill, and connected separately with a single telephone and a small battery to discover a source of water for his castle. He intends to conduct the experiment by night, when disturbing sounds and vibrations of the ground are less frequent than by day. If a stream of water flows near the apparatus, it will pass the sound to the telephone, and thus reveal the spring.—*Oesterr.-Ungar. Post.*

LONGITUDE OF THE ASIATIC COAST.—Several officers of the United States Navy have been detailed to determine the correct longitude of the Asiatic coast of the Pacific Ocean. All points on the coast of Japan and China connected by cable will be visited, and their exact longitude determined. The American officers have permission from the cable companies to establish stations and use the wires at night. Officers of our own navy are now engaged in a similar work in New Zealand and Australia. The information obtained by the observations will be exchanged by the two nations.

INTERNATIONAL ELECTRICAL EXHIBITION.—We learn that the number of French exhibitors at this Exhibition will be more than 800. The refreshment department has been entrusted to M. Ducarre, *L'Electricité* says, "though he is not under any obligation to cook by electricity." Cooking by this means will, however, be practically illustrated by M. Solignac, who has been allowed a room in which to show his experiments with this new help to the cook. If our good friend the *Globe* will take a peep at the Exhibition we have no doubt it will be assured of the error of its ways in stating recently that cooking by electricity could not be.

ELECTRIC RAILWAY AT BERLIN.—On Thursday week, the 12th May, Messrs. Siemens and Halske invited the members of the Municipality and the Press to witness the trial of their new electric railway, running between Lichterfelde and the Cadettenhaus, about six miles from Berlin. The trial, which was most successful, was made with one car. The gauge is 3ft. 3in. The greatest speed obtained over a distance of about one and a half mile was eighteen miles an hour. Dr. Siemens can obtain a far greater speed, but the German police authorities will not permit him to go faster. The railway was to have been opened to the public on the Monday following, that is the 16th May.

TAKING ADVICE.—As if in immediate response to our Note of last week, we hear of the formation of the Electric Gas Lighting Company (Limited), with a capital of £20,000, in shares of £1, formed to purchase inventions for improved apparatus for lighting by gas, and for electric appliances, and any other inventions capable of being used for like purposes, also to adopt and carry into effect an agreement made between C. L. Clark, of Manchester, engineer, and J. Leigh and A. Milne of the same city. The subscribers (who take one share each) are—E. Lever, Bowdon; W. Milne, Chesham; J. F. Turner, Sydenham; A. Stopford, Manchester; F. Macpherson, Wittington; R. Jones, Broughton; W. Botham, Charlton.

PARIS AND FIRE.—The Municipal Council of Paris have refused a credit of 167,000 francs, asked for by the Prefect of Police, to enable a system of fire alarms to be established. *L'Electricité* says:—"For some years the establishment of a system of fire alarms has been put off under various pretexts, meanwhile with a procrastination worthy of the municipal council of Pekin, fire continues its fearful ravages." After the recent example they have had, we must say, we do not wonder at our contemporary's indignation. Perhaps one of the worthy members of the Municipal Council may have the bad luck to be roasted in his bed. We do not doubt that his brethren will then quickly adopt any and every system to save themselves from a similar fate.

THE CANADA CABLE COMPANY.—This company, the Bill for the formation of which was recently before the Dominion House of Commons, is formed to establish communication between the West Coast of Canada and Asia, and is to directly connect American and Canadian towns with those of China and Asia. If this project be carried out, the world will at last be girdled indeed, and if we are inclined to adopt a yankee theory recently promulgated in a Note of ours, some startling effects should take place thereupon. No doubt, however, we shall see what we shall see. The cost of laying the cable, and connecting it with the Canadian land lines is estimated at £800,000, the length of cable required being taken to be the same as that laid between Brest and Massachussetts. The laying of it will take five years.

AN OLD ELECTRIC MOTOR.—In the year 1839 there was a printing press operated in this city (New York) by electricity. The motor consisted of a working-beam about four

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feet in length; from one end descended the connecting-rod to the crank. A rod from the other end terminated in a soft piece of iron, which fitted loosely in a coil of insulated copper wire. The battery consisted of a trough of wood about three feet long, two wide, and one deep, and was hung with alternate sheets of copper and zinc. These were arranged so that they could be raised from the bath of dilute sulphuric acid when the machine was idle. When the current was on the piece of soft iron was drawn into the coil, the current was then broken, when the fly-wheel carried the rod until the current was again engaged. The extreme end of the working beam would lift about 130 pounds.—*Engineering News.*

Re-Vaccination.—An interesting illustration of the value of re-vaccination is afforded by a report just furnished, at the instance of the Local Government Board, by the chief medical officer of the General Post Office. This report relates to an average number of 10,504 persons permanently employed in the postal service in London, all of whom have been required to undergo re-vaccination on admission to the service unless that operation has been performed within seven years previously. In the Telegraph Department, where the enforcement of re-vaccination has not been carried out with quite the same completeness, 12 cases have occurred in the same period among a staff averaging 1,458 in number. Eight of these attacks were of persons who had not been re-vaccinated, and one proved fatal. The remaining four were of re-vaccinated persons, who all perfectly recovered without pitting.

The Chicago Electrical Society.—At a recent meeting of this society Professor E. S. Bastin lectured on "Ozone and Atmospheric Electricity in their Relations to Life." He said, amongst other things, that "While ozone in proper proportions in the atmosphere was a healthy and necessary element of life, if pure it became a dangerous, if not a deadly element of respiration. There were tides in electricity, both daily and yearly, which must be investigated, and would be in the near future. There was a close connection between nervous and electrical force in life. Some portions of the same organism being now negatively, now positively charged, and in different organisms these opposing forces would be found. Very rare instances of highly charged human organisms existed; one or two cases had been cited where sparks an inch in length could be drawn, under favourable circumstances, from the body of the party so naturally electrified."

Swan's Light in Glasgow.—The first exhibition of this light on a practical scale in Glasgow took place on May 12 at the Sauchiehall-street offices of Messrs. D. and G. Graham, licensees for Scotland. These were lighted by thirty Swan lamps, arranged and adapted to suit every description of gas fixture, suspended, bracket, standard, universal joint, and otherwise. A pleasing variety was also attained by the use, in different situations, of plain, figured, opalesque, and tinted globes, and likewise by enclosing some of the lamps, Chinese lantern fashion, in semi-transparent paper shades of novel and tasteful design. One lamp, which attracted particular attention, was shown glowing under water, with gold and silver fish circling round it; whilst another had its connecting wires concealed in a long flexible cord, so that it could be moved about without difficulty. Sir William Thomson, who was among the guests present on the occasion, made some remarks upon incandescent electric lighting, calling attention to the fact that not only could all the lamps in a room be simultaneously extinguished without putting out those in another, but that each individual lamp throughout the premises was under perfect control by means of a small plug switch placed conveniently near it. He also expressed his opinion that the problem of domestic electric lighting was completely solved by the Swan lamp as exhibited that evening, and that its adoption in households would, owing to the non-vitiation of the atmosphere, be of immense sanitary benefit. The above exhibition was planned and carried out by Messrs. D. and G. Graham's engineer, Mr. A. R. Bennett.

The Pay and Status of Telegraph Clerks.—A meeting of the night staff of the London Post Office telegraph clerks was held at the Foresters' Hall, Clerkenwell, on Saturday evening, 14th inst., when a resolution was passed deprecating the delay of the authorities in considering the clerks' grievances. A later gathering for the day staff was also held. It was stated that the department could not carry on the work at the present time unless the clerks worked night and day. Many of them were kept on duty 21 hours of the 24. The number of resignations from their ranks during the past eight-and-a-half years amounted to 2,341, a fact which betrayed the unpopular condition of the service. Many clerks 27 or 28 years of age, married men with families, were receiving only 25s. a week after eight or nine years' service. If they were admitted, as they had a right to be, to the lower grade of Civil servants, they would, on an average, be in receipt of £20 a year more. Grave anxiety was felt at the excessive delay that had taken place, and a general determination was expressed to win their cause at all hazards. Similar meetings were held at some of the large provincial towns. Several leading newspapers, both country and metropolitan, fear that serious consequences may ensue unless some steps are speedily taken to allay the dissatisfaction which now prevails. We think that these apprehensions are premature and needless. A scheme of reorganisation has, we believe, been drawn up, which, if it is sanctioned at the Treasury Office, will be promulgated in due course. Our views are stated at greater length in our leading columns.

The Glasgow Mechanics' Institution.—The annual distribution of prizes to students who have attended lectures at this institution (now known as the College of Science and Arts) during the session of 1880-81 took place on Friday, the 13th inst., in the hall of the institution. Sir W. Thomson presided, and in opening the proceedings alluded to his early acquaintance with the institution, saying that it was through attending its lectures that he had imbibed his first ideas of chemistry.—Sir J. Watson also spoke of his recollections of the early days of the institution, when he had known young men to travel ten or twelve miles to attend the classes, many of whom were now eminent men of business, and had amassed large fortunes. He concluded by announcing that he was going to give £10 for three years in prizes, to be competed for by pupils attending the engineering classes.—Dr. Robertson spoke in high terms of Mr. Jamieson, the principal, for the way in which the work of the institution was carried on. It was announced that the Hutcheson Hospital had made a gift of £600 a year to the institution, and that the Institution of Engineers and Shipbuilders were considering how they could best help their apprentices by getting them to attend three or four sessions' lectures. The hall was lighted up by Swan's lamps, erected by Messrs. D. and G. Graham under the superintendence of Mr. Jamieson, the steam power being supplied by Mr. Gray, of Bath-street. Amongst the prize-winners in the class for electricity and magnetism were:—Senior class: J. Livingstone, special prize, presented by Sir Sir W. Thomson; Junior class: F. B. Robinson, first prize; Robert Logan, second prize; and J. B. Lyle, certificate, all presented by the president, David Rowan, Esq.

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CORRESPONDENCE.

ATLANTIC CABLES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In relation to your perpetual hits as to the ability of the Americans in general, and Gould in particular, to own and operate a cable, I want to ask you one question. Is the English Post Office bound by any contract rights to receive only the business of the existing companies? If not, what is to prevent its entering into relations with a new company owned by Gould. On the other side of the water there is only the Western Union. Without that connection the cables might as well be cut in the middle of the Atlantic. Given a cable so cut, it seems to me competition with it would not be disastrous.

In justice to all sides will you let this appear in your columns. —Yours, &c.,

PHILIP WALKER.

[We believe the English Government will not enter into any arrangements with a new company differing from those it has with existing companies. Mr. Jay Gould has much to fear, however, from concerted action by the existing companies. There is no reason why, with an outlay of 10,000,000 dollars, they should not build land lines, and compete with the gigantic company of Gould. With one-eighth of the capital such competition would undoubtedly obtain from 50 to 80 per cent. of the business. We do not speak at random when we say that the germs of such competition exist already, and are likely to bear fruit.—ED. *E.*]

THE MORSE ALPHABET.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The prolonged delay of the authorities in considering the grievances of the telegraph clerks has caused several meetings to be held lately, at which the delegates deprecated the indifference of the Postmaster-General to the complaints which they have made. The growing impression that arrangements are being quietly matured at the Post Office, in order to lessen the serious effects to the public of a general strike, which seems imminent if the reasonable demands of the clerks are not promptly granted, is also strengthened by the official announcement of further vacant posts for telegraph learners.

I am myself very much surprised that the telegraph alphabet is virtually allowed to remain in this country a sort of Post Office monopoly. Being, as it certainly is, the only existing language in use all over the whole world, why is it not, I would ask, more systematically taught?

Why should not our type founders cast it in vertical form, and our School Board print a few books therefrom? The question of transmitting and reading language in those signs would thereby be so materially and practically advanced that the form of the instruments most suitable for speedy and accurate communication would be a very simple matter to dispose of.—Yours, &c.,

RICHARD HERRING.

THE RESISTANCE OF PLUMBAGO PAPER.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Can you or any of your readers inform me whether experiments have been made proving that "plumbago paper," with regard to "resistance," is affected during electrical tests by "light" and "darkness," and whether the results of such experiments have been published?—Yours, &c.,

C. H. B.

April 23, 1881.

ELECTRIC LIGHT AND GAS.—The *Scientific American* gives an account of an experiment made to ascertain how gas and the electric light would harmonise for lighting a picture gallery. It says:—"One part of the gallery of the Union League Club House, New York, was lighted with gas, and the other portion with Maxim's incandescent burners, supplied by the United States Electric Lighting Company, who also illuminated the street and avenue fronting the building with one of their powerful arc lights. It was considered doubtful if the commingling of the two lights—gas and electric—would be sufficiently harmonious to admit their use together without destroying the harmony of colour or richness of tint in some of the beautiful paintings which adorned the walls of the Club House on this occasion. But the result has proved that the electric light is feasible for illuminating galleries of art, and in many respects that it is far better than gas for the purpose. The quality of the light approaches very closely to that of daylight, hence the artist's conception of colour is not distorted as by the yellow tint which gas produces. The picture appears to the observer as it did to the artist when it left his easel. The Maxim incandescent burners were placed at intervals between the gas jets on the main pipe which extends around the room, so that the rays of light were projected from the same line, thus avoiding a cross-light, which artists and exhibitors so much abhor."

RADIOPHONY AT THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

An interesting account of recent researches in Radiophony was given by W. H. PREECE, F.R.S., at this Society's meeting on Thursday evening, 12th May, Professor Adams in the chair. The lecturer began by briefly recapitulating the original accounts of Graham Bell's investigations and his distinct announcement that the phenomena of the photophone was due to light. This conjecture, however, was at once called in question in France; and Professor Tyndall in this country attributed the effect almost exclusively to heat. Since then several persons of considerable experimental skill had engaged in this field of research, and had each of them arrived at pretty much the same results. It was curious to note the various stages of the investigation indicated in the titles of the papers that had been published. First we had the paper "Upon the Production and Reproduction of Light;" this was altered a little later to "Radiant Energy;" Mercadier had adopted "Radiophony," and had adhered to it; Dr. Tyndall's paper was entitled "Action of an Intermittent Beam of Radiant Heat on Gaseous Matter;" Mr. Preece himself had originally described the account of his own experiments as "The Conversion of Radiant Energy into Sound," but altered the last word subsequently to "sonorous vibrations." On the whole, Radiophony seemed to be the most expressive and comprehensive title, and he had adopted it on this occasion, because it included radiant energy together with its photophonic, thermophonic, and actinophonic effects. It should be noted that radiant heat was motion of ether, whilst thermometric heat was motion of matter. Bearing this distinction in mind, and the further definition of a "ray" as a thin line of light, and "beam" as a bundle of such rays, the experiments which the lecturer proposed to perform would, he thought, be intelligible to everybody present.

An oxy-hydrogen lamp was employed, and its beam of bright light being duly focussed, it was interrupted by a whirling disc perforated at short intervals near the edge. A lens distributed the beam upon the diaphragm of a small box, to which, on its farther side, was affixed a flexible tube and earpiece. Professor Hughes was the listener, and the sounds were described and approximately measured by him. The first diaphragm tested was a thin disc of ebonite, and as this material allows only the lower waves to pass through, the sounds which were heard were apparently caused by the action of thermometric heat inside the box. But the question still arose, is this due to expansion and contraction following each other very rapidly? Every care had been taken to detect such movement, but nothing of the kind was discoverable. The phenomenon appeared rather to be due to molecular pressure, acting in some such manner as that exhibited in the later form of radiometer, where the shower of molecules from the blackened surfaces causes a mica disc, suspended over them, to revolve in an opposite direction. At all events, it was not caused by the vibration of the diaphragm, for a cracked and broken diaphragm, as shown by Mercadier, made no difference to the sounds, nor did the material of which the diaphragm was composed affect the note, its *timbre* in every case being exactly the same.

Another experiment was tried without any diaphragm, and the sounds, though much feebler, were audible. When, however, the interior surface was blackened with the smoke of burnt camphor the sounds rose as from 5 to 50. A tube with blackened wire gauze inside gave similar results, as did also the smoked interiors of flasks and test tubes, the phenomena connected with all of which, however, have already been described in these columns. Graham Bell's latest experiments, including those with worsted of various colours, were next gone through, and explained on the theory that the sounds emitted were due to the power of the coloured material to convert radiant energy into thermometric heat. Mr. Preece showed that the fibrous or spongy character of the material had not, as Graham Bell supposed, very much to do with the effects, and he thought that in all probability the ingenious American would finally come round to those views which had found most acceptance in Europe. Mr. Bell had, however, made one or two very important discoveries since his visit to England, and his new instrument, called the spectrophone, would be acceptable to experimentalists as a valuable adjunct to the spectroscope. We print Mr. Bell's account of these discoveries in another column, and we need not repeat them here. The spectrophone, however, curiously confirmed his, Mr. Preece's, theory in explanation of these phenomena, for it showed that whenever a substance was placed in the spectroscopic rays, where its colour became black, then the sounds grew loudest. Another discovery, curiously coincidene with one made by Mercadier, was the possibility of communicating directly by means of light, the reflected rays of which were caused to vibrate, not by a whirling disc, but simply by the

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voice directed against a thin reflector. Falling upon a distant diaphragm these rays caused it to vibrate correspondingly, and words spoken at the reflecting end could be plainly heard at the receiver.

The lecturer then explained how, from conjecturing that the sonorous vibrations were due to the heat rays rather than to the light rays, he had inferred that the heat arising from an electric current, suitably interrupted, would produce these sonorous vibrations. This he found to be the case, and had even transmitted articulate speech on this principle. A microphone in another apartment was connected to a coil of platinum wire enclosed in a little box or earpiece, and the listener (Professor Adams) by this means was able to hear and understand what was being said at the transmitter. This was unquestionably due to heat; and the inference from the other experiments was that the beam falling upon certain bodies—notably, a blackened surface—was converted into thermometric heat, which in its turn, acting upon the air molecules, was converted into the sonorous vibrations conveyed to the ear by the flexible tube. It may be mentioned here that the sounds were described by Professor Hughes as resembling that of a tuning fork, and were often quite as loud. In one experiment, when a blackened test tube was placed very near to the revolving wheel, and a conical paper trumpet took the place of the ordinary earpiece, the audience distinctly heard the sound, which to them appeared like the familiar "twang" emitted by a steel spring when suddenly released.

In answer to Mr. Crompton, who pointed out that there might be molecular disturbance without its being detected by any known means, Mr. Preece repeated that he did not doubt there was molecular disturbance; but all he could say was that they had not been able to detect it, and he was sure that there was no disturbance of the kind called vibration such as usually gives rise to sonorous waves.

Mr. Le Fevre, as an amateur balloonist, contributed his experience of what had appeared to him as sound reading by means of the sun's rays. He had noticed that voices plainly heard when the sun was shining became inaudible when its light was obscured, and that from different parts of the same playground childrens' cries were audable, or inaudible, depending upon whether they were on the shady or the illuminated side of it. He had also reason to believe that when the sun was setting and was therefore in a direct line with the balloon, the sounds of the sea waves could then be heard at a very great distance. Further experiments in this direction, Mr. Le Fevre thought, would be highly valuable as bearing upon the subject of radiophony.

Dr. Moser made a brief statement with reference to some recent experiments of his with the selenium cell, and was understood to state that the whole effects were in reality microphonic, their origin being at the junction of the wire with the selenium.

After a cordial vote of thanks to Mr. Preece, the meeting was adjourned to May 26, when a paper will be read on "Military Telegraphs in Relation to the Afghanistan Campaign," by Mr. P. V. Luke.

THE PHYSICAL SOCIETY.—May 14, 1881.

Professor Fuller in the chair.

Electric Absorption in Crystals.

Professor Foster read a communication from Professor Rowland and Mr. E. H. Nichols of Baltimore, U.S., on "Electric Absorption in Crystals." According to the theory of Clausius, Maxwell, and others, there should be no electric absorption in the case of perfectly homogeneous substances. Professor Rowland tested this deduction in the case of glass—which is not quite homogeneous—quartz, and calcite. This was done by placing the material as the dielectric in a condenser formed of two amalgamated copper plates. The condenser was charged by six Leyden jars, and the absorption measured by a quadrant electrometer. The results were that quartz had about one-ninth the absorptive power of glass, and calcite none at all, a fact which makes it useful for the construction of standard condensers.

Dr. Hopkinson said that the kind of glass was important, and threw doubts on the theory that the absorption was due to heterogeneity. Paraffin wax had little absorptive power, and yet was very heterogeneous.

Professors Perry and Ayrton thought that two non-homogeneous substances in combination might have a residual charge.

Mr. Lewis Wright suggested that the optical character of crystals should be considered in these experiments, which might be extended to other crystals. Calcite is uniaxial.

Absolute Sine Galvanometer.

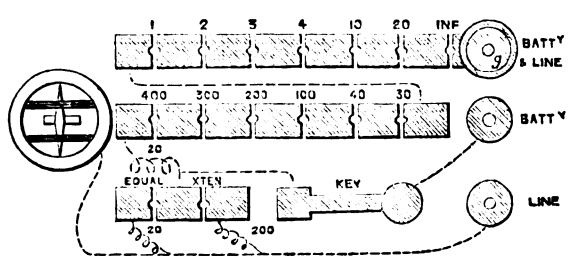
Professor Minchin, of Cooper's Hill Engineering College, described his new absolute sine electrometer. This consists of two metal plates, in one of which is an aperture nearly closed by a metal trap-door, suspended from the upper edge of the plate by two fine platinum wires, and resting against fine stops when the plates are hung vertically. These plates are connected to the poles of the cell to be measured, and tilted out of the vertical till the attraction of the whole plate on the suspended trap or shutter is just balanced by the weight of the latter. The electromotive force is then proportional to the sine of the angle of displacement. The elements to be known are the area of the disc, the distance between the two parallel plates, and the angle through which they are tilted. The area is carefully measured once for all, so is the distance between the plates. The latter is the most difficult quantity to get, and is best obtained by means of a spirometer. The apparatus has been constructed, and is now at University College, where measurements have been successfully made with it Dr. Lodge remarked that it combined sensitiveness with practicality. The electromotive force of a single cell could be measured by it, whereas Thomson's absolute electrometer could only give the total effect of a number of cells. Professor Ayrton stated that he and Professor Perry hoped to modify the instrument in the direction of sensitiveness by adding another plate and giving that a high charge.

The Ascent of Bulbs through a Liquid.

Professor Foster read a paper by Dr. J. E. Mills, "On the Ascent of Hollow Glass Bulbs through a Liquid." These bulbs rapidly acquired a uniform velocity of ascent. The time of ascent was found proportional to the square of the diameter of the containing vessel in his experiments, and as it depended also on the density of the contents of the bulb, it afforded a means of measuring that property.

APPLICATION OF LIGHTNING CONDUCTORS TO BUILDINGS.

An interesting lecture on the application of lightning conductors to buildings and magazines was delivered by Captain Bucknill, R.E., at the Royal United Service Institution, on Friday, the 6th instant. The lecturer, who was employed by the War Department last summer in testing lightning conductors, pointed out the enormous interests at stake and the loss to the war strength of Great Britain which would be occasioned by the explosion of one of the large magazines at Portsmouth. Such an explosion would develop "nearly one thousand millions of foot tons of energy," and would practically destroy Portsmouth and perhaps one-half of its inhabitants. The lecturer advocated the use of iron in preference to copper for lightning conductors, giving many reasons for the opinion. An earth connection of at least 24 square feet of surface in contact with water or moist earth was considered as necessary. The safe circle theory of Mr. Preece and others was examined, and arguments brought to bear against its reliability. Wire ropes were recommended in preference to rods, tubes, bands, &c. Multiple points were preferred to single points for the top rods, and reasons given for the preference. Both deep and shallow earth connections were recommended, the one being efficient in droughts, and the other after recent rains. The employment of a horizontal gathering conductor to connect all the vertical conductors and the feet of all rain-water pipes with the various earths and with each other was urged. Objections were made to any kind of joint which is not soldered or run with molten zinc. Periodical inspection was advocated, as well as electrical testing when the conductors are continuous, but the opinion was expressed that electrical testing is of little or no value when the conductors are jointed with rivetted lap, or with screwed, or with sliding joints. During the lecture the theory of the thunderstorm was most carefully explained, and reasons given for lightning visiting damp situations, although low-lying, in preference to non-conducting areas of even considerable altitude.



The lecturer exhibited an apparatus which he has recently registered, and which consists of a small box of resistance coils and a galvanometer with key and bridging coils permanently

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onnected, and to which a small battery may or may not be permanently connected also as desired. This instrument is very light and handy; it can test by units up to 1,110 ohms, by tens up to 11,100 ohms, and its utility is evidently not limited to testing lightning conductors. It is made and sold by Messrs. Elliott Bros.

THE ELECTRIC AND THERMAL CONDUCTIVITIES OF METALS.

It has been assumed since the experiments of Wiedemann and Franz*, of Neumann† and of Lenz‡, that the electric conductivities and the thermal conductivities of different metals are proportional to each other.

The subject has been recently taken up by Herr H. F. Weber, who has determined the absolute values of these conductivities for the same strip of different metals. To determine the thermal conductivity he followed the plan of allowing a ring of the metal to cool in a space kept at constant temperature, and he finds that the specific heat of unit volume and the interior and exterior conductivities are not constant, as is supposed in the theory of Fourier, but linear functions of the temperature, as appears to result from all known experiments. A section of the ring was heated to a known temperature, and the law of cooling observed in two sections conveniently chosen.

The general result of this first series of measurements was that the two coefficients which characterise the external conductivity are the same for all metals. As for the internal conductivity the values found by Herr Weber, reduced to zero temperature, are as follow (the fundamental units being the centimetre, gramme, and second):—

Metals.	K_0.
Copper	0·8190
Silver	1·0960
Cadmium	0·2213
Zinc	0·3056
Brass	0·1509
Tin	0·1446

The absolute conductivity of the rings which gave the above thermal results was measured by an electro-magnetic method. The ring to be measured was fixed upon a frame of wood, so that the plane of its axis was vertical and parallel to the magnetic meridian. In its immediate neighbourhood a strong magnet was placed with its middle in the axis of the ring, and at a small distance from its plane. The decreasing oscillations of the magnet, due to the ring, were then observed, and the total resistance of the ring was calculated by Weber's formula, and hence also the specific conductivity of a cube of the same metal of unit length in side.

The electric conductivities are linear functions of the temperature. Herr Weber found for their values reduced to zero temperature the following figures:—

Metal	χ_0
Copper	$40{\cdot}81 \times 10^{-5}$
Silver	$65{\cdot}87 \times 10^{-5}$
Cadmium	$14{\cdot}61 \times 10^{-5}$
Zinc	$17{\cdot}43 \times 10^{-5}$
Brass	$7{\cdot}62 \times 10^{-5}$
Tin	$10{\cdot}34 \times 10^{-5}$

The ratio of electric and thermal conductivities at zero temperature (0°C) is from these two tables.

Metal.	$\frac{K_0}{\chi_0}$	Specific Heat of unit volume C_0.
Copper	$0{\cdot}2007 \times 10^4$	0·827
Silver	$0{\cdot}1664 \times 10^4$	0·578
Cadmium	$0{\cdot}1515 \times 10^4$	0·475
Zinc	$0{\cdot}1753 \times 10^4$	0·662
Brass	$0{\cdot}1968 \times 10^4$	0·791
Tin	$0{\cdot}1398 \times 10^4$	0·380

This ratio varies, then, for one metal and another. But Herr Weber thinks that the values which he has given for the thermal conductivities are exact to 1 per cent., those of electric conductivities to ½ per cent. of their value. The variation of the ratio with the nature of the metal would therefore be a real one.

An examination of the values of this ratio show that it is strictly connected with the specific heat C_0 of unit volume. If we place

$$\frac{K_0}{\chi_0} = a + b\,C_0$$

and if we determine a and b by observations made on metals which have extreme values of specific heat, copper, and tin, we find:—

$$a = 0{\cdot}0880 \times 10^4$$
$$b = 0{\cdot}1365 \times 10^4$$

The other metals give

Metals.	$\frac{K_0}{\chi_0}$ Calculated.	$\frac{K_0}{\chi_0}$ Observed.
Brass	$0{\cdot}1960 \times 10^4$	$0{\cdot}1968 \times 10^4$
Zinc	$0{\cdot}1784 \times 10^4$	$0{\cdot}1753 \times 10^4$
Silver	$0{\cdot}1664 \times 10^4$	$0{\cdot}1662 \times 10^4$
Cadmium	$0{\cdot}1528 \times 10^4$	$0{\cdot}1515 \times 10^4$

Herr Weber has extended his results, by a method slightly different, to metals less conductive than the above-named—lead, Wood's metal, and bismuth. They satisfy, as does mercury, the same empirical relation.

Metal.	K_0	χ_0	C_0	$\frac{K_0}{\chi_0}$ Observed.	$\frac{K_0}{\chi_0}$ Calculated.
Mercury	0·0152	$1{\cdot}047 \times 10^{-5}$	0·441	$0{\cdot}1452 \times 10^4$	$0{\cdot}1475 \times 10^4$
Wood's Metal.	0·0319	$2{\cdot}313 \times 10^{-5}$	0·371	$0{\cdot}1379 \times 10^4$	$0{\cdot}1373 \times 10^4$
Lead	0·0719	$5{\cdot}351 \times 10^{-5}$	0·340	$0{\cdot}1345 \times 10^4$	$0{\cdot}1339 \times 10^4$
Bismuth	0·0108	$0{\cdot}838 \times 10^{-5}$	0·293	$0{\cdot}1288 \times 10^4$	$0{\cdot}1275 \times 10^4$

He further observes that the result of his experiments is not in disaccord with those of Lenz and Neumann, who have only operated on copper, brass, silver, and iron, whose specific heats, reduced to unit volume, are 0·83, 0·80, 0·80, and 0·84. For these metals the ratio $\frac{K_0}{\chi_0}$ should have values very close, as different experimenters have found.

Other unpublished researches seem to establish the fact that the relation between the two sorts of conductivity applies to amalgams, but not to non-metallic conductors. For carbon, the thermal conductivity, according to Herr Zeller, is at least from ten to twenty times greater than that deduced from its electric conductivity and specific heat.

ELECTRICAL DISTRIBUTION OF TIME.

There is a proposal now under consideration to adopt the Paris method of distributing standard time from an astronomical clock to different local public clocks throughout the city of London. Uniform time is much needed in London, where all the town clocks are more or less at variance with each other, and the town clocks with the railway station timepieces. It is debateable, however, if electricity should not be at once adopted in preference to the pneumatic system of Paris. Electrically timed clocks will, doubtless, supersede those timed by the clumsier pneumatic system sooner or later, and it might be a saving of much capital, sunk in pneumatic apparatus, if they were adopted in London in the first place.

One drawback to the electrical transmission of time in a successful manner has hitherto been the unsteadiness of battery power, but the introduction of the dynamo-electric generator will overcome this in the future.

The electric system of Messrs. Barraud and Lund has proved itself successful, though it is, perhaps, a little more complex than is absolutely necessary. In Glasgow public clocks are erected at the corners of all the principal thoroughfares, and regulated by electricity from the University Observatory. The simplest plan we have seen for effecting the same end is that devised by Mr. F. E. Fahrig, electrician, Southampton. It consists of a regulator clock which winds itself up periodically by an automatic action, and distributes pulses of electricity to a main circuit throwing off branch circuits in which are placed the local dials. The regulator is so constructed that *every hour* two contact springs are pressed together and close the circuit of a battery kept in the lower part of the clock case. The current started passes through an electro-magnet, attracting its keeper, and by the agency of a train of mechanism winds the weight of the clock up through the distance it has fallen in the past hour. So long as the battery continues to work this regulator is quite automatic, and, indeed, the entire system is automatic.

The time of this regulator, which is kept at the central station

* *Pogg Ann.*, *t* 59, *p.* 530.
† *Annales de Chimie et Physique* (*3rd Series*), *t* 66, *p.* 185.
‡ *Bull. Acad., St. Petersburg*, *t* 15, 54.

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is dispensed to the local dials in the following manner:—The main circuit proceeding from the station sends out branch circuits to "earth" wherever a local dial is wanted. This dial is not a clock in the ordinary sense. It is simply a dial with an escapement wheel and hands. An electro-magnet is, however, attached in such a way that when a current traverses it the minute hand can be shifted by the current through a minute space on the dial, or one tooth on the centre wheel carrying the hand. The current is sent by the regulator every minute, and thus all the dials in the branched circuit are kept at one time.

A PORTABLE ABSOLUTE GALVANOMETER FOR STRONG CURRENTS.

This instrument has been designed by Professors W. E. Ayrton and John Perry, and is made by Mr. Paterson, of Little Britain. The apparatus can be used for measuring directly in webers, without calculation or reference to any table, the strongest electric light current, and the accuracy of its readings can at any moment be checked by the employment of only one single Daniell cell. Our description of the instrument is obtained from Professors Ayrton and Perry's paper, read before the Society of Telegraph Engineers.

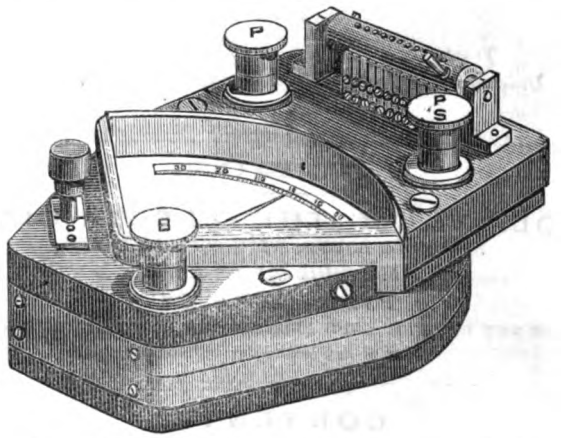
A galvanometer, to be something more than a mere galvanoscope, must, of course, be calibrated—that is, the relative strengths of the current, producing different deflections must be ascertained. In certain cases, as, for example, with the tangent and sine galvanometer, this relative calibration can be effected by mathematical calculation; usually, however, it must be done by experiment. One well-known method consists in sending a current simultaneously though a standard galvanometer and the galvanometer to be calibrated, and varying the current in any convenient way. A number of simultaneous readings of the two galvanometers being taken, a curve is constructed, having for abscissæ the observed deflections on the galvanometer under test, and for ordinates the relative values of the currents, and from which the relative strengths of the currents producing any two deflections may be seen at once. When, however, a standard galvanometer is unattainable a current may be sent through the galvanometer to be calibrated, various known resistances being simultaneously put into circuit; then, as the current is inversely proportional to the resistance, the relative strengths of the currents corresponding with any two deflections may be easily calculated. A third method consists in always bringing the needle or movable part of the apparatus back to the zero position by the introduction of a variable measurable force, in which case, whatever be the shape or size of the apparatus, the strength of the current can always be determined from the return force employed.

But for a galvanometer to be employed for the practical measurements of electric light currents, we must know not only the relative strengths of the currents producing any two deflections, but also the absolute value in webers of one of them; we must not only have the galvanometer *relatively* calibrated, but also *absolutely* calibrated. If the galvanometer be a tangent one, the absolute value of a current can, as is well known, be ascertained from the number of turns of wire in the coil, and its linear dimensions, provided also that we know the absolute strength of the horizontal magnetic field in which the needle moves. Now, although the strength of the earth's magnetic field in London is known with great accuracy, the actual field in a workshop is so modified by the iron machinery in the neighbourhood that we cannot, from the published tables of magnetic force, even approximate to the strength of the magnetic field in which our experiments are made.

When weak currents have to be measured, the work is simple enough; but with large electric light currents it is much more difficult, since we run great risk of heating the resistance coils, and so making our current much less than we intend it to be; and this difficulty of constructing and using special resistance coils of very thick German silver wire, &c., has delayed Messrs. Breguet in the calibration and issue of the Deprez galvanometer.

We want, then, a small dead-beat galvanometer to use with strong currents, but which may be calibrated absolutely with a single Daniell cell, and such an instrument was designed for the students in the Course of Electric Lighting at the City and Guilds Laboratory, Finsbury.

The small instrument shown in the illustration is very dead beat, this result being attained partly by the lightness of the needle and pointer, and partly from its moving in a very strong permanent magnetic field. The needle is balanced, and consequently the deflections are about the same for any position of the instrument. By a proper arrangement of the coils the deflections are directly proportional to the current, and one degree deflection is produced by a current of two webers, the greatest deflection, 45°, being produced, therefore, by a current of 90 webers. The main peculiarity of the instrument is the following:—The thick wire coiled round the needle, and through which the electric light current circulates, is in reality a strand or little cable composed of ten insulated wires. Each of these wires having the same resistance, equal portions of the strong current flow through each of them. To produce a deflection even of 5° requires a current of 10 webers, but by means of a simple commutator the ten wires, which are normally



joined in multiple arc, can, by a mere turn of the hand, be connected in series, and then a current of exactly one-tenth part, or one weber, will produce 5° deflection. To ascertain, then, the real value of any deflection, all that has to be done is as follows:—Turn the commutator to series, and send a current from a single cell—a Daniell or a Grove—of which the electromotive force E, but not necessarily the resistance, is known. A certain deflection $a°$ is produced. Now take out the plug of the one-ohm resistance coil attached to the instrument, and a deflection $b°$ is obtained. Then the resistance of the instrument, the wires, and the cell is

$$\frac{b°}{a° - b°} \text{ ohms},$$

or the deflection $a°$ in the instrument is produced by

$$\frac{E(a° - b°)}{b°} \text{ webers}$$

when the wires are joined in series, or by

$$\frac{E(a° - b°)}{b°} \times 10 \text{ webers}$$

when in parallel circuit.

Example.—With a Grove cell you see that a deflection of 7°·4 is obtained on the instrument before you when the coils are in series, and 4°·1 when the one-ohm resistance is inserted. The resistance, then, of the coils, the connecting wires, and the galvanometer $\frac{b°}{a° - b°} = 1{\cdot}24$ ohms; or as the electromotive force of a Grove cell is 1·8 volts, a current of $\frac{1{\cdot}8}{1{\cdot}24}$, or 1·45 webers, produces a deflection of 7°·4, or one weber will produce about 5° with the coils in series, and therefore ½° with the coils in multiple arc. Consequently, currents from 0 to 9 webers can be measured when the coils are in series, and from 0 to 90 webers when in multiple arc, without any calculation or reference to tables.

While, then, with the ordinary instruments employed for measuring strong currents, the absolute value of any deflection can only be checked by employing a current of known strength, and as strong as the one the instrument is employed to measure, with the instrument before you the strong current necessary to produce any given deflection when the coils are in multiple arc is exactly ten times as strong as the comparatively weak and easily producible current of known strength which produces the same deflection when the coils are in series.

To render it impossible for the electric light current to be passed through the coils when in series, the binding screws, marked PP, and to which the wires from the dynamo machine are attached, are only in circuit when the commutator is turned to parallel; the common screw, marked also S, and the third screw, marked S, being only in circuit when the commutator is turned to series. Neither the coils of the galvanometer nor the one-ohm resistance coil, then, can be damaged by the commutator being left accidentally in a wrong position.

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THE GRIEVANCES OF TELEGRAPH CLERKS.

Some months ago* we stated our views with regard to the disaffection which was then ripening in the telegraph service, and which has since assumed a more threatening aspect than we anticipated. As a large portion of our article was reprinted amongst a collection of opinions extracted from public prints and distributed by the clerks themselves, we may assume that our remarks were not altogether adverse to their claims. This being so, we feel the more free to express our entire dissent from the proceedings which, if they are correctly reported, the promoters of the agitation have countenanced and encouraged of late. Pertinacity is a good quality, and a firm front is sound policy; but the precipitate and unseemly attempts to force the hand of the Postmaster-General are both impertinent and imprudent. It is always wise to appear to trust one's adversary, for to openly suspect him is to invite the very treachery we fear. If the malcontents obtain from the chief whom they have sought to terrify all, or nearly all, that they ask of him, they will, in our opinion, receive not only justice but a considerable allowance of mercy into the bargain.

We have never doubted that the aggrieved clerks would have their case looked into and equitably dealt with, but we have not concealed our opinion that the inflated and highly-coloured portions of their memorial would collapse. It is a bad sign that these exaggerations continued to find utterance at the several public demonstrations last Saturday. We feel confident, nevertheless, that what a public functionary has publicly promised he is bound to, and is sure, to, fulfil. Moreover, it is well known in London that for some weeks past the officials have been busily engaged in provisionally remodelling the scales of pay for the telegraph staff, and that various committees presided over by the Postmaster-General have considered these schemes. It is even believed that a definite decision, liberally framed, has been come to, and that the sanction of Downing-street is now all that is needed. A delay occasioned by this necessity ought to be awaited with patience, for of course it means a demand—necessarily a large demand—upon the public funds. The Treasury is notoriously a close-fisted body, and it is perhaps to be regretted that a more public inquiry—such, for instance, as a Parliamentary committee—did not take this matter in hand at the first, whose decision would have certainly had more Parliamentary weight than the recommendations of the head of a department. The problematical "two hundred" members of Parliament who are claimed as the friends of the clerks may probably soon have their sincerity put to the test.

Meanwhile, nothing is to be gained by bullying the one friend who, in their estimation, has the power to serve them, or by misstatements which the public would soon find out if matters were pushed to extremities. We fail to see how the number of resignations, even if they are disproportionately large, can be a grievance to the clerks who remain; and as work for "twenty-one hours out of every twenty-four" is a physical impossibility we do not think that either Parliament, the Press, or the public will continue their sympathy for long with a movement supported by such reckless language. As to a "strike" we refuse to believe that a suggestion so malevolent and so suicidal is seriously entertained. The telegraph clerks as a body have undoubtedly some claims which are entitled to be satisfied, and they have grievances which ought to be redressed; but unless they have lost all self-respect and all regard for public opinion they will never be guilty of that last and most pernicious folly of the British workman, refusing to work.

Electrician, January 29th, 1881.

THE PARIS ELECTRICAL EXHIBITION.

Very great progress is being made in Paris to render the forthcoming exhibition a success. The number of applicants for space in France is enormous, and amounts to not less than 800. For the British section sixty-four exhibitors have applied. The apportionment of the space has been completed, and the lion's share has been given to England. The Post Office will make a very fine display of old apparatus. It was thought at one time that England would figure but very poorly, but, thanks to the energy that has been displayed by the Society of Telegraph Engineers, this fear has been removed, and there is no doubt that our display will compare very favourably with that of other countries. One interesting feature of the exhibition will be the historical arrangement of old apparatus employed by the original discoverers, such as Œrsted, Ampère, Faraday, Wheatstone, and others. The Council of King's College and the Managers of the Royal Institution have separately and independently agreed to lend apparatus illustrating the labours of our two English electricians. Sir William Thomson is going to exhibit his own apparatus, and it is hoped that the building will be surmounted by a lighthouse working on his occulting method.

There was a meeting of the exhibitors at the Society of Telegraph Engineers on Thursday last, when arrangements were discussed for uniform and general action.

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UPON THE PRODUCTION OF SOUND BY RADIANT ENERGY.*

BY ALEXANDER GRAHAM BELL.

In a paper read before the American Association for the Advancement of Science, last August, I described certain experiments made by Mr. Sumner Tainter and myself which had resulted in the construction of a "Photophone," or apparatus for the production of sound by light; and it will be my object to-day to describe the progress we have made in the investigation of photophonic phenomena since the date of that communication.

In my Boston paper the discovery was announced that thin discs of very many different substances emitted sounds when exposed to the action of a rapidly-interrupted beam of sunlight. The great variety of material used in these experiments led me to believe that sonorousness under such circumstances would be found to be a general property of all matter.

At that time we had failed to obtain audible effects from masses of the various substances which became sonorous in the condition of thin diaphragms, but this failure was explained upon the supposition that the molecular disturbance produced by the light was chiefly a surface action, and that under the circumstances of the experiments the vibration had to be transmitted through the mass of the substance in order to affect the ear. It was, therefore, supposed that, if we could lead to the ear air that was directly in contact with the illuminated surface, louder sounds might be obtained, and solid masses be found to be as sonorous as thin diaphragms. The first experiments made to verify this hypothesis pointed towards success. A beam of sunlight was focussed into one end of an open tube, the ear being placed at the other end. Upon interrupting the beam, a clear, musical tone was heard, the pitch of which depended upon the frequency of the interruption of the light and the loudness upon the material composing the tube.

At this stage our experiments were interrupted, as circumstances called me to Europe. While in Paris a new form of the experiment occurred to my mind, which would not only enable us to investigate the sounds produced by masses, but would also permit us to test the more general proposition that sonorousness, under the influence of intermittent light, is a property common to all matter. The substance to be tested was to be placed in the interior of a transparent vessel, made of some material which (like glass) is transparent to light, but practically opaque to sound.

Under such circumstances the light could get in, but the sound produced by the vibration of the substance could not get out. The audible effects could be studied by placing the ear in communication with the interior of the vessel by means of a hearing-tube.

Some preliminary experiments were made in Paris to test this idea, and the results were so promising that they were communicated to the French Academy on the 11th of October, 1880, in a note read for me by M. Antoine Breguet. Shortly afterwards I wrote to Mr. Tainter, suggesting that he should carry on the investigation in America, as circumstances prevented me from doing so myself in Europe. As these experiments seemed to have formed the common starting-point for a series of independent researches of the most important character, carried on simultaneously in America by Mr. Tainter, and in Europe by M. Mercadier, Professor Tyndall. W. E. Röntgen, and W. H. Preece, I may be permitted to quote from my letter to Mr. Tainter the passage describing the experiments referred to:—

"Metropolitan Hotel, Rue Cambon, Paris,
"November 2nd, 1880.

"DEAR MR. TAINTER: * * * I have devised a method of producing sounds by the action of an intermittent beam of light from substances that cannot be obtained in the shape of thin diaphragms or in the tubular form; indeed, the method is specially adapted to testing the generality of the phenomenon we have discovered, as it can be adapted to solids, liquids, and gases.

"Place the substance to be experimented with in a glass test-tube, connect a rubber tube with the mouth of the test-tube, placing the other end of the pipe to the ear. Then focus the intermittent beam upon the substance in the tube. I have tried a large number of substances in this way with great success, although it is extremely difficult to get a glimpse of the sun here, and when it does shine the intensity of the light is not to be compared with that to be obtained in Washington. I got splendid effects from crystals of bicromate of potash, crystals of sulphate of copper, and from tobacco smoke. A whole cigar placed in the test-tube produced a very loud sound. I could not hear anything from plain water, but when the water was discoloured with ink a feeble sound was heard. I would suggest that you might repeat these experiments and extend the results," &c., &c.

Upon my return to Washington in the early part of January, Mr. Tainter communicated to me the results of the experiments he had made in my laboratory during my absence in Europe.

He had commenced by examining the sonorous properties of a vast number of substances inclosed in test-tubes in a simple empirical search for loud effects. He was thus led gradually to the discovery that cotton-wool, worsted, silk, and fibrous materials generally, produced much louder sounds than hard rigid bodies like crystals, or diaphragms such as we had hitherto used. In order to study the effects under better circumstances he inclosed his materials in a conical cavity in a piece of brass closed by a flat plate of glass. A brass tube leading into the cavity served for connection with the hearing-tube. When this conical cavity was stuffed with worsted or other fibrous materials the sounds produced were much louder than when a test-tube was employed. This form of receiver is shown in Fig. 1.

Mr. Tainter next collected silks and worsteds of different colours, and speedily found that the darkest shades produced the best effects. Black worsted especially gave an extremely loud sound. As white cotton-wool had proved itself equal, if not superior, to any other white fibrous material before tried, he was anxious to obtain coloured specimens for comparison. Not having any at hand, however, he tried the effect of darkening some cotton-wool with lamp-black. Such a marked reinforcement of the sound resulted that he was induced to try lamp-black alone. About a teaspoonful of lamp-black was placed in a test-tube and exposed to an intermittent beam of sunlight. The sound produced was much louder than any heard before. Upon smoking a piece of plate-glass, and holding it in the intermittent beam with the lamp-black surface towards the sun, the sound produced was loud enough to be heard, with attention, in any part of the room. With the lamp-black surface turned from the sun the sound was much feebler. Mr. Tainter repeated these experiments for me immediately upon my return to Washington, so that I might verify his results. Upon smoking the interior of the conical cavity shown in Fig. 1, and then exposing it to the intermittent beam, with the glass lid in position as shown, the effect was perfectly startling. The sound was so loud as to be actually painful to an ear placed closely against the end of the hearing-tube. The sounds, however, were sensibly louder when we placed some smoked wire gauze in the receiver, as illustrated in the drawing, Fig. 1. When the beam was thrown into a resonator, the interior of which had been smoked over a lamp, most curious alternations of sound and silence were observed. The interrupting disc was set rotating at a high rate of speed, and was then allowed to come gradually to rest. An extremely feeble musical tone was at first head, which gradually fell in pitch as the rate of interruption grew less. The loudness of the sound produced varied in the most interesting manner. Minor reinforcements were constantly occurring, which became more and more marked as the true pitch of the resonator was neared. When at last the frequency of interruption corresponded to the frequency of the fundamental of the resonator, the sound produced was so loud that

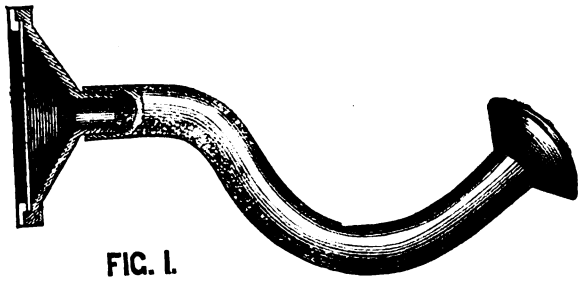

FIG. I.

it might have been heard by an audience of hundreds of people. The effects produced by lamp-black seemed to me to be very extraordinary, especially as I had a distinct recollection of experiments made in the summer of 1880 with smoked diaphragms, in which no such reinforcement was noticed. Upon examining the records of our past photophonic experiments we found the following note:—

"Experiment V.—Mica diaphragm covered with lamp-black on the side exposed to light.

"Result: distinct sound, about same as without lamp-black.—A. G. B., July 18th, 1880.

"Verified the above, but think it somewhat louder than when used without lamp-black.—S. T., July 18th, 1880."

Upon repeating this old experiment we arrived at the same result as that noted. Little if any augmentation of sound resulted from smoking the mica. In this experiment the effect was observed by placing the mica diaphragm against the ear and also by listening through a hearing-tube, one end of which was closed by the diaphragm. The sound was found to be more audible through the free air when the ear was placed as near to the lamp-black surface as it could be brought without shading it.

At the time of my communication to the American Association I had been unable to satisfy myself that the substances which had become sonorous under the direct influence of intermittent sunlight were capable of reproducing the sounds of articulate speech under the action of an undulatory beam from our photophonic transmitter. The difficulty in ascertaining this will be understood by considering that the sounds emitted by thin diaphragms and tubes were so feeble that it was impracticable to produce audible effects from substances in these conditions at any considerable distance away from the transmitter; but it was equally impossible to judge of the effects produced by our articulate transmitter at a short distance away because the speaker's voice was directly audible through the air. The extremely loud sounds produced from lamp-black have enabled us to demonstrate the feasibility of using this substance in an articulating photophone in place of the electrical receiver formerly employed.

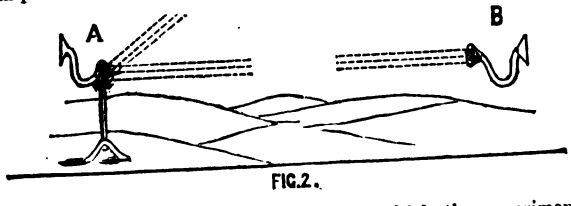

FIG. 2.

The drawing (Fig. 2) illustrates the mode in which the experiment was conducted. The diaphragm of the transmitter A was only 5 centimetres in diameter, the diameter of the receiver B was also 5 centimetres, and the distance between the two was 40 metres, or 800 times the diameter of the transmitting diaphragm. We were unable to experiment at greater distances without a heliostat on account of the difficulty of keeping the light steadily directed on the receiver. Words and sentences spoken into the transmitter in a low tone of voice were audily reproduced by the lamp-black receiver.

In Fig. 3 is shown a mode of interrupting a beam of sunlight for producing distant effects without the use of lenses. Two similarly-perforated discs are employed, one of which is set in rapid rotation, while the other remains stationary. This form of interrupter is also admirably adapted for work with artificial light. The receiver illustrated in the drawing consists of a parabolic reflector, in the focus of which is placed a glass vessel, A, containing lamp-black or other sensitive substance, and connected with a hearing-tube. The beam of light is interrupted by its passage through the two slotted discs shown at B, and in operating the instrument musical signals like the dots and dashes of the Morse alphabet are produced from the sensitive receiver A, by slight motions of the mirror C, about its axis, D.

In place of the parabolic reflector shown in the figure, a conical reflector

* A Paper read before the National Academy of Arts and Sciences, April 21st, 1881.

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like that recommended by Professor Sylvanus Thompson can be used, in which case a cylindrical glass vessel would be preferable to the flask A shown in the figure.

In regard to the sensitive materials that can be employed, our experiments indicate that in the case of solids the physical condition and the colour are two conditions that markedly influence the intensity of the sonorous effects. The loudest sounds are produced from substances in a loose, porous, spongy condition, and from those that have the darkest or most absorbent colours. The materials from which the best effects have been produced are cotton-wool, worsted, fibrous materials generally, cork,

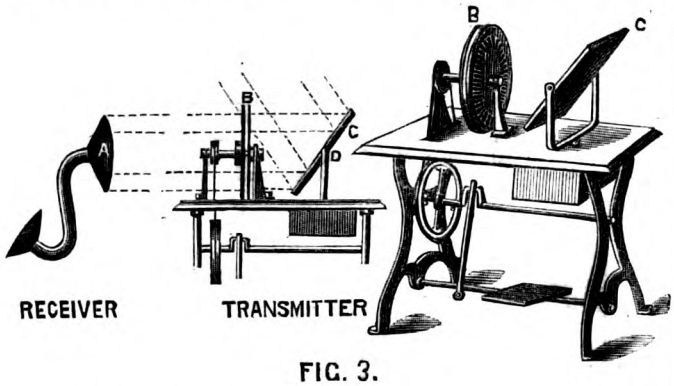

FIG. 3.

sponge, platinum, and other metals in a spongy condition, and lamp-black. The loud sounds produced from such substances may perhaps be explained in the following manner:—Let us consider, for example, the case of lamp-black—a substance which becomes heated by exposure to rays of all refrangibility. I look upon a mass of this substance as a sort of sponge, with its pores filled with air instead of water. When a beam of sunlight falls upon this mass, the particles of lamp-black are heated, and consequently expand, causing a contraction of the air-spaces or pores among them. Under these circumstances a pulse of air should be expelled, just as we would squeeze out water from a sponge. The force with which the

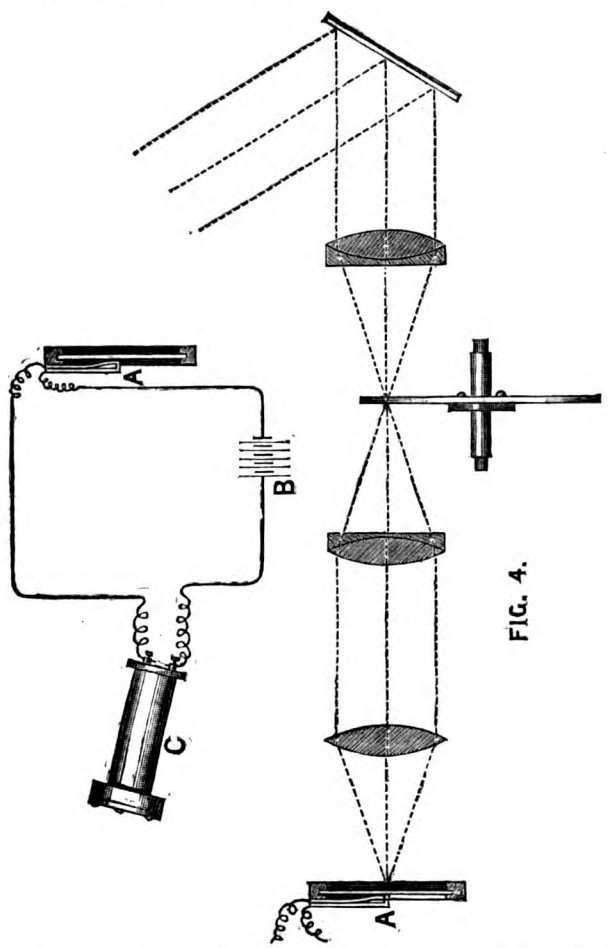

FIG. 4.

air is expelled must be greatly increased by the expansion of the air itself, due to contact with the heated particles of lamp-black. When the light is cut off the converse process takes place. The lamp-black particles cool and contract, thus enlarging the air spaces among them, and the inclosed air also becomes cool. Under these circumstances a partial vacuum should be formed among the particles, and the outside air would then be absorbed, as water is by a sponge when the pressure of the hand is removed. I imagine that in some such manner as this a wave of condensation is started in the atmosphere each time a beam of sunlight falls upon lamp-black, and a wave of rarefaction is originated when the light is cut off. We can thus understand how it is that a substance like lamp-black produces intense sonorous vibrations in the surrounding air, while at the same time it communicates a very feeble vibration to the diaphragm or solid bed upon which it rests. This curious fact was independently observed in England by Mr. Preece, and it led him to question whether, in our experiments with thin diaphragms, the sound heard was due to the vibration of the disc or (as Prof. Hughes had suggested) to the expansion and contraction of the air in contact with the disc confined in the cavity behind the diaphragm. In his paper read before the Royal Society on the 10th March, Mr. Preece describes experiments from which he claims to have proved that the effects are wholly due to the vibrations of the confined air, and that the discs do not vibrate at all. I shall briefly state my reasons for disagreeing with him in this conclusion:—

1. When an intermittent beam of sunlight is focussed upon a sheet of hard rubber or other material, a musical tone can be heard, not only by placing the ear immediately behind the part receiving the beam, but by placing it against any portion of the sheet, even though this may be a foot or more from the place acted upon by the light.

2. When the beam is thrown upon the diaphragm of a "Blake Transmitter," a loud musical tone is produced by a telephone connected in the same galvanic circuit with the carbon button A (Fig. 4). Good effects are also produced when the carbon button A forms, with the battery B, a portion of the primary circuit of an induction coil, the telephone C being placed in the secondary circuit.

In these cases the wooden box and mouth-piece of the transmitter should be removed, so that no air-cavities may be left on either side of the diaphragm.

It is evident, therefore, that in the case of thin discs a real vibration of the diaphragm is caused by the action of the intermittent beam, independently of any expansion and contraction of the air confined in the cavity behind the diaphragm.

Lord Rayleigh has shown mathematically that a to-and-fro vibration, of sufficient amplitude to produce an audible sound, would result from a periodical communication and abstraction of heat, and he says:—"We may conclude, I think, that there is at present no reason for discarding the obvious explanation that the sounds in question are due to the bending of the plates under unequal heating." Mr. Preece, however, seeks to prove that the sonorous effects cannot be explained upon this supposition; but his experimental proof is inadequate to support his conclusion. Mr. Preece expected that if Lord Rayleigh's explanation was correct, the expansion and contraction of a thin strip under the influence of an intermittent beam could be caused to open and close a galvanic circuit so as to produce a musical tone from a telephone in the circuit. But this was an inadequate way to test the point at issue, for Lord Rayleigh has shown that an audible sound can be produced by a vibration whose amplitude is less than a ten-millionth of a centimetre, and certainly such a vibration as that would not have sufficed to operate a "make-and-break contact" like that used by Mr. Preece. The negative results obtained by him cannot, therefore, be considered conclusive.

The following experiments (devised by Mr. Tainter) have given results decidedly more favourable to the theory of Lord Rayleigh than to that of Mr. Preece:—

1. A strip, A, similar to that used in Mr. Preece's experiment, was attached firmly to the centre of an iron diaphragm, B, as shown in Fig. 5, and was then pulled taut at right angles to the plane of the diaphragm. When the intermittent beam was focussed upon the strip A, a clear musical tone could be heard by applying the ear to the hearing tube C.

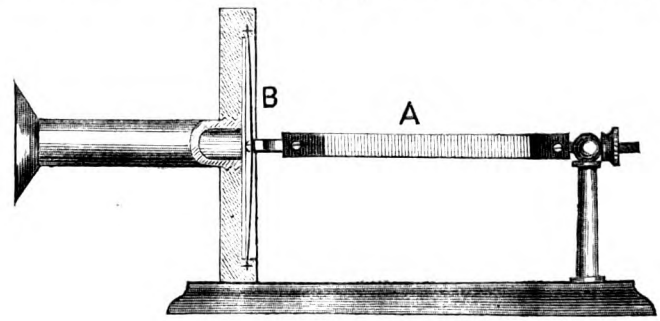

FIG. 5

This seemed to indicate a rapid expansion and contraction of the substance under trial. But a vibration of the diaphragm B would also have resulted if the thin strip A had acquired a to-and-fro motion, due either to the direct impact of the beam or to the sudden expansion of the air in contact with the strip.

2. To test whether this had been the case an additional strip, D, was attached by its central point only to the strip under trial, and was then submitted to the action of the beam, as shown in Fig. 6.

It was presumed that if the vibration of the diaphragm B had been due to a pushing force acting on the strip A that the addition of the strip D would not interfere with the effect. But if, on the other hand, it had been due to the longitudinal expansion and contraction of the strip A the sound would cease, or at least be reduced. The beam of light falling upon strip D was now interrupted as before by the rapid rotation of a perforated disc, which was allowed to come gradually to rest. No sound was heard excepting at a certain speed of rotation, when a feeble musical tone became audible.

This result is confirmatory of the first. The audibility of the effect at a particular rate of interruption suggests the explanation that the strip D had a normal rate of vibration of its own. When the frequency of the interruption of the light corresponded to this, the strip was probably thrown into vibration after the manner of a tuning fork, in which case a to-and-fro vibration would be propagated down its stem or central support to the strip A. This indirectly proves the value of the experiment. The list of solid substances that have been submitted to experiment in my laboratory is too long to be quoted here, and I shall merely say that we have not yet

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found one solid body that has failed to become sonorous under proper conditions of experiment.*

EXPERIMENTS WITH LIQUIDS.

The sounds produced by liquids are much more difficult to observe than those produced by solids. The high absorptive power possessed by most liquids would lead one to expect intense vibrations from the action of intermittent light, but the number of sonorous liquids that have so far been found is extremely limited, and the sounds produced are so feeble as to be heard only by the greatest attention and under the best circumstances of experiment. In the experiments made in my laboratory a very long test tube was filled with the liquid under examination, and a flexible rubber tube was slipped over the mouth far enough down to prevent the possibility of any light reaching the vapour above the surface. Precautions were also taken to prevent reflection from the bottom of the test tube. An intermittent beam of sunlight was then focussed upon the liquid in the middle portion of the test tube by means of a lens of large diameter.

RESULTS.

Clear water	No sound audible.
Water discoloured by ink	Feeble sound.
Mercury	No sound heard.
Sulphuric ether*	Feeble, but distinct sound.
Ammonia	,, ,, ,,
Ammonia-sulphate of copper	,, ,, ,,
Writing ink	,, ,, ,,
Indigo in sulphuric acid	,, ,, ,,
Chloride of copper*	,, ,, ,,

The liquids distinguished by an asterisk gave the best sounds.

Acoustic vibrations are always much enfeebled in passing from liquids to gases, and it is probable that a form of experiment may be devised which will yield better results by communicating the vibrations of the liquid to the ear through the medium of a solid rod.

EXPERIMENTS WITH GASEOUS MATTER.

On the 29th of November, 1880, I had the pleasure of showing to Professor Tyndall in the laboratory of the Royal Institution the experiments described in the letter to Mr. Tainter from which I have quoted above, and

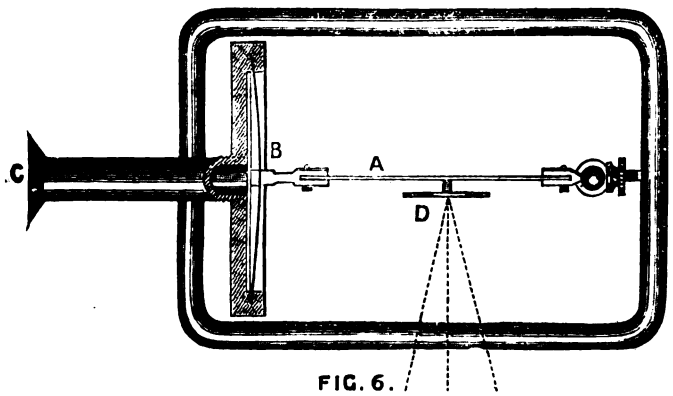

FIG. 6.

Professor Tyndall at once expressed the opinion that the sounds were due to rapid changes of temperature in the body submitted to the action of the beam. Finding that no experiments had been made at that time to test the sonorous properties of different gases, he suggested filling one test-tube with the vapour of sulphuric ether (a good absorbent of heat) and another with the vapour of bisulphide of carbon (a poor absorbent), and he predicted that if any sound was heard it would be louder in the former case than in the latter.

The experiment was immediately made, and the result verified the prediction.

Since the publication of the memoirs of Röntgen and Tyndall we have repeated these experiments, and have extended the inquiry to a number of other gaseous bodies, obtaining in every case similar results to those noted in the memoirs referred to.

The vapours of the following substances were found to be highly sonorous in the intermittent beam :—Water vapour, coal gas, sulphuric ether, alcohol, ammonia, amylene, ethyl bromide, diethylamene, mercury, iodine, and peroxide of nitrogen. The loudest sounds were obtained from iodine and peroxide of nitrogen.

I have now shown that sounds are produced by the direct action of intermittent sunlight from substances in every physical condition (solid, liquid, and gaseous), and the probability is, therefore, very greatly increased that sonorousness under such circumstances will be found to be a universal property of matter.

UPON SUBSTITUTES FOR SELENIUM IN ELECTRICAL RECEIVERS.

At the time of my communication to the American Association the loudest effects obtained were produced by the use of selenium, arranged in a cell of suitable construction, and placed in a galvanic circuit with a telephone. Upon allowing an intermittent beam of sunlight to fall upon the selenium a musical tone of great intensity was produced from the telephone connected with it.

But the selenium was very inconstant in its action. It was rarely, if ever, found to be the case, that two pieces of selenium, even of the same stick, yielded the same results under identical circumstances of annealing, &c. While in Europe last autumn, Doctor Chichester Bell, of University College, London, suggested to me that this inconstancy of result might be due to chemical impurities in the selenium used. Dr. Bell has since visited my laboratory in Washington, and has made a chemical examination of the various samples of selenium I had collected from different parts of the world. As I understand it to be his intention to publish the results of this analysis very soon, I shall make no further mention of his investigation than to state that he has found sulphur, iron, lead, and arsenic in the so-called "selenium," with traces of organic matter; that a quantitative examination has revealed the fact that sulphur constitutes nearly one per cent. of the whole mass; and that when these impurities are eliminated the selenium appears to be more constant in its action and more sensitive to light.

Prof. W. G. Adams has shown that tellurium, like selenium, has its electrical resistance affected by light, and we have attempted to utilise this substance in place of selenium. The arrangement of cell (shown in Fig. 7) was constructed for this purpose in the early part of 1880; but we failed at that time to obtain any indications of sensitiveness with a reflecting galvanometer. We have since found, however, that when this tellurium spiral is connected in circuit with a galvanic battery and telephone, and

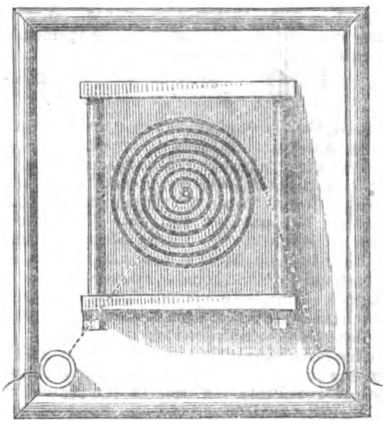

FIG. 7.

exposed to the action of an intermittent beam of sunlight, a distinct musical tone is produced by the telephone. The audible effect is much increased by placing the tellurium cell with the battery in the primary circuit of an induction coil, and placing the telephone in the secondary circuit. The enormously high resistance of selenium and the extremely low resistance of tellurium suggested the thought that an alloy of these two substances might possess intermediate electrical properties. We have accordingly mixed together selenium and tellurium in different proportions, and while we do not feel warranted at the present time in making definite statements concerning the results, I may say that such alloys have proved to be sensitive to the action of light.

It occurred to Mr. Tainter before my return to Washington last January that the very great molecular disturbance produced in lamp-black by the action of intermittent sun-light should produce a corresponding disturbance in an electric current passed through it, in

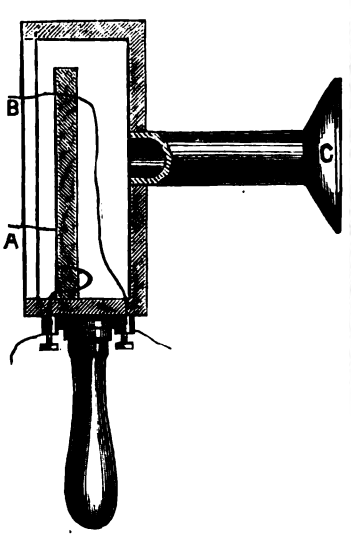

FIG. 9.

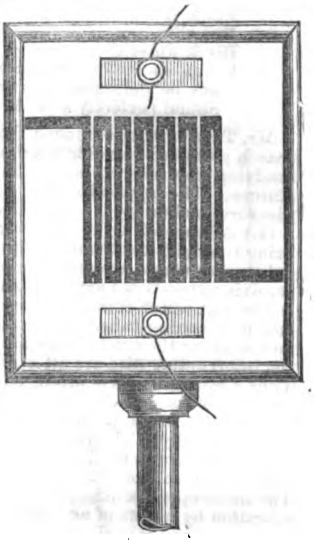

FIG. 8.

which case lamp-black could be employed in place of selenium in an electric receiver. This has turned out to be the case, and the importance of the discovery is very great, especially when we consider the expense of such rare substances as selenium and tellurium. The form of lamp-black cell we have found most effective is shown in Fig. 8. Silver is deposited upon a plate of glass, and a zigzag line is then scratched through the film, as shown, dividing the silver surface into two portions insulated from one another, having the form of two combs with interlocking teeth. Each comb is attached to a screw-cup, so that the cell can be placed in an electrical circuit when required. The surface is then smoked until a good film of lamp-black is obtained, filling the interstices between the teeth of the silver combs. When the lamp-black cell is connected with a telephone and galvanic battery, and exposed to the influence of an intermittent beam of sun-light, a loud musical tone is produced by the telephone. This result seems to be due rather to the physical condition than to the nature of the conducting material employed, as metals in a

* Carbon and thin microscope glass are mentioned in my Boston paper as non-responsive, and powdered chlorate of potash in the communication to the French Academy (*Comptes Rendus*, vol. xci., p. 595). All these substances have since yielded sounds under more careful conditions of experiment.

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spongy condition produce similar effects. For instance, when an electrical current is passed through spongy platinum while it is exposed to intermittent sun-light, a distinct musical tone is produced by a telephone in the same circuit. In all such cases the effect is increased by the use of an induction coil, and the sensitive cells can be employed for the reproduction of articulate speech as well as for the production of musical sounds.

We have also found that loud sounds are produced from lamp-black by passing through it an intermittent electrical current; and that it can be used as a telephonic receiver for the reproduction of articulate speech by electrical means.

A convenient mode of arranging a lamp-black cell for experimental purposes is shown in Fig. 9. When an intermittent current is passed through the lamp-black A, or when an intermittent beam of sunlight falls upon it through the glass plate B, a loud musical tone can be heard by applying the ear to the hearing-tube C. When the light and the electrical current act simultaneously, two musical tones are perceived, which produce beats when nearly of the same pitch. By proper arrangements a complete interference of sound can undoubtedly be produced.

Upon the Measurement of the Sonorous Effects Produced by Different Substances.

We have observed that different substances produce sounds of very different intensities under similar circumstances of experiment, and it has appeared to us that very valuable information might be obtained if we could measure the audible effects produced. For this purpose we have constructed several different forms of apparatus for studying the effects, but as our researches are not yet complete I shall confine myself to a simple description of some of the forms of apparatus we have devised. When a beam of light is brought to a focus by means of a lens, the beam diverging from the focal point becomes weaker as the distance increases in a calculable degree. Hence, if we can determine the distances from the focal point at which two different substances emit sounds of equal intensity, we can calculate their relative sonorous powers. Preliminary experiments were made by Mr. Tainter during my absence in Europe to ascertain the distance from the focal point of a lens at which the sound produced by a substance became inaudible. A few of the results obtained will show the enormous differences existing between different substances in this respect.

Distance from Focal Point of Lens at which Sounds become Inaudible with Different Substances.

Zinc diaphragm (polished)	1·51 m.
Hard rubber diaphragm	1·90 ,,
Tin-foil ,,	2·00 ,,
Telephone ,, (Japanned iron)	2·15 ,,
Zinc ,, (unpolished)	2·15 ,,
White silk (in receiver shown in Fig. 1)	3·10 ,,
White worsted ,, ,,	4·01 ,,
Yellow worsted ,, ,,	4·06 ,,
Yellow silk ,, ,,	4·13 ,,
White cotton wool ,, ,,	4·38 ,,
Green silk ,, ,,	4·52 ,,
Blue worsted ,, ,,	4·69 ,,
Purple silk ,, ,,	4·82 ,,
Brown silk ,, ,,	5·02 ,,
Black silk ,, ,,	5·21 ,,
Red silk ,, ,,	5·24 ,,
Black worsted ,, ,,	6·50 ,,
Lamp-black. In receiver the limit of audibility could not be determined on account of want of space. Sound perfectly audible at a distance of	10·00 ,,

Mr. Tainter was convinced from these experiments that this field of research promised valuable results, and he at once devised an apparatus for studying the effects, which he described to me upon my return from Europe. The apparatus has since been constructed, and I take great pleasure in showing it to you to-day.

(1.) A beam of light is received by two similar lenses, Fig. 10, which bring the light to a focus on either side of the interrupting disc. The two substances whose sonorous powers are to be compared are placed in the receiving vessels (so arranged as to expose equal surfaces to the action of the beam), which communicate by flexible tubes, of equal length, with the common hearing-tube. The receivers are placed upon slides, which can be moved along the graduated supports. The beams of light passing through the interrupting disc are alternately cut off by the swinging of a pendulum. Thus a musical tone is produced. One of the receivers is kept at a constant point upon its scale, and the other receiver is moved towards or from the focus of its beam until the ear decides that the sounds produced are of equal intensity. The relative positions of the receivers are then noted.

(2.) Another method of investigation is based upon the production of an interference of sound, and the apparatus employed is shown in Fig. 11. The interrupter consists of a tuning-fork, A, which is kept in continuous vibration by means of an electro-magnet, B.

A powerful beam of light is brought to a focus between the prongs of the tuning-fork A, and the passage of the beam is more or less obstructed by the vibration of the opaque screens C D carried by the prongs of the fork. As the tuning-fork A produces a sound by its own vibration, it is placed at a sufficient distance away to be inaudible through the air, and a system of lenses is employed for the purpose of bringing the undulating beam of light to the receiving lens E with as little loss as possible. The two receivers F G are attached to slides H I, which move upon opposite sides of the axis of the beam, and the receivers are connected by flexible tubes of unequal length, K L, communicating with the common hearing-tube M. The length of the tube K is such that the sonorous vibrations from the receivers F G reach the common hearing tube M in opposite phases. Under these circumstances silence is produced when the vibrations in the receivers F G are of equal intensity. When the intensities are unequal, a residual effect is perceived. In operating the instrument the position of the receiver G remains constant, and the receiver F is moved to or from the focus of the beam until complete silence is produced. The relative positions of the two receivers are then noted.

(3.) Another mode is as follows:—The loudness of a musical tone produced by the action of light is compared with the loudness of a tone of similar pitch produced by electrical means. A rheostat introduced into the circuit enables us to measure the amount of resistance required to render the electrical sound equal in intensity to the other.

(4.) If the tuning-fork A in Fig. 11 is thrown into vibration by an undulatory instead of an intermittent current passed through the electro-magnet B it is probable that a musical tone, electrically produced in the receiver F by the action of the same current, would be found capable of extinguishing the effect produced in the receiver G by the action of the undulatory beam of light, in which case it should be possible to establish an acoustic balance between the effects produced by light and electricity by introducing sufficient resistance into the electric circuit.

Upon the Nature of the Rays that produce Sonorous Effects in Different Substances.

In my paper read before the American Association last August, and in the present paper, I have used the word "light" in its usual rather than its scientific sense, and I have not hitherto attempted to discriminate the effects produced by the different constituents of ordinary light—the thermal, luminous, and actinic rays. I find, however, that the adoption of

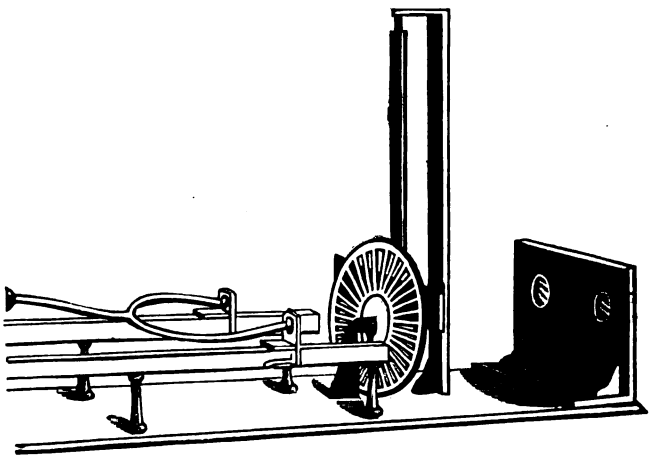

FIG. 10.

the word "photophone" by Mr. Tainter and myself has led to the assumption that we believed the audible effects discovered by us to be due entirely to the action of luminous rays. The meaning we have uniformly attached to the words "photophone" and "light" will be obvious from the following passage, quoted from my Boston paper:—

"Although effects are produced as above shown by forms of radiant energy, which are invisible, we have named the apparatus for the production and reproduction of sound in this way the 'photophone,' *because an ordinary beam of light contains the rays which are operative.*"

To avoid in future any misunderstandings upon this point, we have decided to adopt the term "*radiophone*," proposed by M. Mercadier, as a general term signifying an apparatus for the production of sound by any form of radiant energy, limiting the words *thermophone*, *photophone*, and *actinophone*, to apparatus for the production of sound by thermal, luminous, or actinic rays respectively.

M. Mercadier, in the course of his researches in radiophony, passed an intermittent beam from an electric lamp through a prism, and then examined the audible effects produced in different parts of the spectrum. (*Comptes Rendus*, Dec. 6, 1880.)

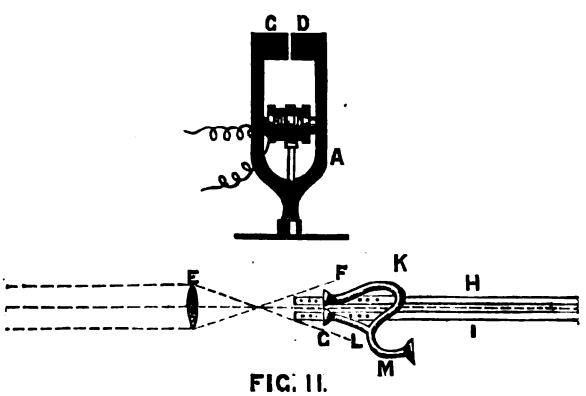

FIG. 11.

We have repeated this experiment, using the sun as our source of radiation, and have obtained results somewhat different from those noted by M. Mercadier.

A beam of sunlight was reflected from a heliostat, A, Fig. 12, through an achromatic lens, B, so as to form an image of the sun upon the slit C.

The beam then passed through another achromatic lens, D, and through a bisulphide of carbon prism, E, forming a spectrum of great intensity, which, when focussed upon a screen, was found to be sufficiently pure to show the principal absorption lines of the solar spectrum.

The disc-interrupter F was then turned with sufficient rapidity to produce from five to six hundred interruptions of the light per second, and the spectrum was explored with the receiver G, which was so arranged that the lamp-black surface exposed was limited by a slit as shown.

Under these circumstances sounds were obtained in every part of the visible spectrum, excepting the extreme half of the violet, as well as in the ultra-red. A continuous increase in the loudness of the sound was observed upon moving the receiver G gradually from the violet into the ultra-red.

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The point of maximum sound lay very far out in the ultra-red. Beyond this point the sound began to decrease, and then stopped so suddenly that a very slight motion of the receiver G made all the difference between almost maximum sound and complete silence.

(2.) The lamp-blacked wire gauze was then removed and the interior of the receiver G was filled with red worsted. Upon exploring the spectrum as before entirely different results were obtained. The maximum effect was produced in the green at that part where the red worsted appeared to be black. On either side of this point the sound gradually died away, becoming inaudible on the one side in the middle of the indigo, and on the other at a short distance outside the edge of the red.

(3.) Upon substituting green silk for red worsted the limits of audition appeared to be the middle of the blue and a point a short distance out in the ultra-red. Maximum in the red.

(4.) Some hard rubber shavings were now placed in the receiver G. The limits of audibility appeared to be on the one hand the junction of the green and blue, and on the other the outside edge of the red. Maximum in the yellow. Mr. Tainter thought he could hear a little way into the

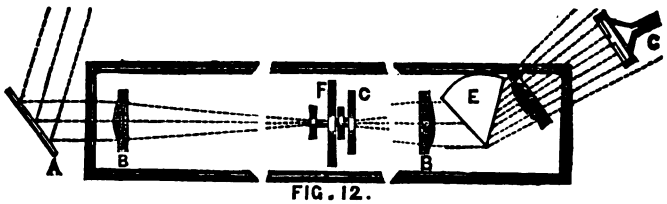

FIG. 12.

ultra-red, and to his ear the maximum was about the junction of the red and orange.

(5). A test-tube containing the vapour of sulphuric ether was then substituted for the receiver G. Commencing at the violet end, the test-tube was gradually moved down the spectrum and out into the ultra-red without audible effect, but when a certain point far out in the ultra-red was reached a distinct musical tone suddenly made its appearance, which disappeared as suddenly on moving the test-tube a very little further on.

(6.) Upon exploring the spectrum with a test-tube containing the vapour of iodine the limits of audibility appeared to be the middle of the red and the junction of the blue and indigo. Maximum in the green.

(7.) A test-tube containing peroxide of nitrogen was substituted for that containing iodine. Distinct sounds were obtained in all parts of the visible spectrum, but no sounds were observed in the ultra-red.

The maximum effect seemed to me to be in the blue. The sounds were well marked in all parts of the violet, and I even fancied that the audible effect extended a little way into the ultra-violet, but of this I cannot be certain. Upon examining the absorption spectrum of peroxide of nitrogen it was at once observed that the maximum sound was produced in that

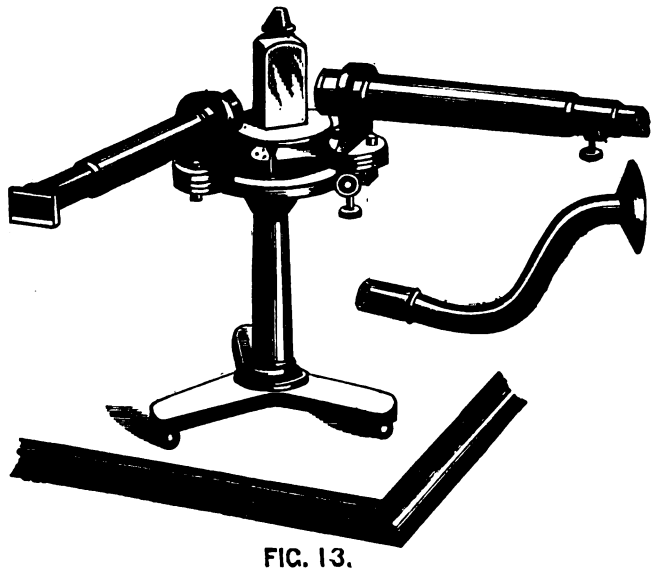
FIG. 13.

part of the spectrum where the greatest number of absorption lines made their appearance.

(8.) The spectrum was now explored by a selenium cell, and the audible effects were observed by means of a telephone in the same galvanic circuit with the cell. The maximum effect was produced in the red. The audible effect extended a little way into the ultra-red on the one hand and up as high as the middle of the violet on the other.

Although the experiments so far made can only be considered as preliminary to others of a more delicate kind, I think we are warranted in concluding that the nature of the rays that produce sonorous effects in different substances depends upon the nature of the substances that are exposed to the beam, and that the sounds are in every case due to those rays of the spectrum that are absorbed by the body.

The Spectrophone.

Our experiments upon the range of audibility of different substances in the spectrum have led us to the construction of a new instrument for use in spectrum analysis, which was described and exhibited to the Philosophical Society of Washington last Saturday.* The eye-piece of a spectroscope is removed, and sensitive substances are placed in the focal point of the instrument behind an opaque diaphragm containing a slit. These substances are put in communication with the ear by means of a hearing-tube, and thus the instrument is converted into a veritable "spectrophone," like that shown in Fig. 13.

Suppose we smoke the interior of our spectrophonic receiver, and fill the cavity with peroxide of nitrogen gas. We have then a combination that gives us good sounds in all parts of the spectrum (visible and invisible) except the ultra-violet. Now, pass a rapidly-interrupted beam of light through some substance whose absorption spectrum is to be investigated, and bands of sound and silence are observed upon exploring the spectrum, the silent positions corresponding to the absorption bands. Of course, the ear cannot for one moment compete with the eye in the examination of the visible part of the spectrum; but in the invisible part beyond the red, where the eye is useless, the ear is invaluable. In working in this region of the spectrum lamp-black alone may be used in the spectrophonic receiver. Indeed, the sounds produced by this substance in the ultra-red are so well marked as to constitute our instrument a most reliable and convenient substitute for the thermo-pile. A few experiments that have been made may be interesting.

(1.) The interrupted beam was filtered through a saturated solution of alum.

Result: The range of audibility in the ultra-red was slightly reduced by the absorption of a narrow band of the rays of lowest refrangibility. The sounds in the visible part of the spectrum seemed to be unaffected.

(2.) A thin sheet of hard rubber was interposed in the path of the beam.

Result: Well-marked sounds in every part of the ultra-red. No sounds in the visible part of the spectrum, excepting the extreme half of the red.

These experiments reveal the cause of the curious fact alluded to in my paper read before the American Association last August—that sounds were heard from selenium when the beam was filtered through both hard rubber and alum at the same time.

(3.) A solution of ammonia-sulphate of copper was tried.

Result: When placed in the path of the beam the spectrum disappeared, with the exception of the blue and violet end. To the eye the spectrum was thus reduced to a single broad band of blue-violet light. To the ear, however, the spectrum revealed itself as two bands of sound with a broad space of silence between. The invisible rays transmitted constituted a narrow band just outside the red.

I think I have said enough to convince you of the value of this new method of examination, but I do not wish you to understand that we look upon our results as by any means complete. It is often more interesting to observe the first totterings of a child than to watch the firm tread of a full-grown man, and I feel that our first footsteps in this new field of science may have more of interest to you than the fuller results of mature research. This must be my excuse for having dwelt so long upon the details of incomplete experiments.

I recognise the fact that the spectrophone must ever remain a mere adjunct to the spectroscope, but I anticipate that it has a wide and independent field of usefulness in the investigation of absorption spectra in the ultra-red.

* *Proc. of Phil. Soc. of Washington*, April 16, 1881.

WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).

The eighth ordinary general meeting of the members of this Company was held on the 18th instant, under the presidency of Mr. C. W. Earle.

The Secretary (Mr. Constantine M. Hooper) read the notice convening the meeting, and the minutes of the last meeting, which were confirmed by the present meeting, and signed by the chairman as correct.

The Chairman, in moving the adoption of the report and the accounts stated that the accounts showed a balance of expenditure over revenue of £9,258. In the previous half year the balance was £14,824 the other way, so that the result of the year's working was a profit of £5,566, and that without considering any depreciation of the cables. This was a sorry result indeed for the expenditure of so much capital, and he might say so much labour and anxiety as they had to give to this concern; but the reason of the exceptional bad year which they had had was not very far to seek. The numerous interruptions of the cables accounted for the falling off in the traffic receipts, and the necessary repairs to the cables accounted for the large increase in the expenses of the cable repairs and shipping. It was one of the misfortunes of this particular Company, so largely dependent as it was on subsidies, that the effect of these interruptions was so seriously cumulative. Not only did their traffic and their revenue cease at the time they were obliged to incur considerable expense in repairing the damages, but most of the colonies at the same moment shut off their subsidies. Their position under such circumstances was one of considerable difficulty; and not only was it the loss which they sustained at the moment, but also the damage done to their credit, the uncertainty of the revenue, and the difficulty of finding the means, under such conditions, for raising money for the renewal of the cables or whatever might be required to be done to the system. Turning to the accounts, he stated that they had somewhat altered the form of presenting the revenue account. He stated that the general expenses in London and the working expenses at the stations were shown in full in Abstracts A and B, but in Abstract C the most important variation had been made. Formerly they used to lump the expenses of the ships, whether in harbour or on repairs, into one item, but now they were detailed, so as to show the number of days the ship was actually employed at sea, and how many days she was in harbour. He thought this would be regarded as a satisfactory arrangement of the account. At the last meeting some rather severe remarks were made as to the expenses of the ships; but the scale on which the crew of a ship were paid and victualled was arranged in conformity with the current prices obtaining in every telegraph ship they could arrive at. It would be impossible for them to attempt, particularly in such work, to have a scale very much below the current rate of wages and remuneration existing elsewhere. He did not know any operation employing a large number of men where it was more important to have the hearty co-operation of every one engaged—perhaps there was no service in which a disaffected or discontented man could do more harm without being observed. It was ridiculous to talk of the expenses of a telegraph ship in the tropics, and the crew performing such delicate work, being the same as on the Tyne. They had repeatedly pointed out that the time

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would come when it would be advisable to make representations to the colonies as to the conditions which were accepted originally by this Company, with which conditions the present board had nothing to do, and it was in pursuance of those intimations that they had deputed Mr. Grosvenor to proceed to the West Indies, and to lay their case before the various Governments and publics of those colonies. He could not flatter himself that there had been any marked success attending that gentleman's mission; but, still, several colonies had consented to their proposals. Some had been more liberal than they asked, while others were less generous; but he thought, perhaps, that the result of the whole would be a general amelioration in the existing terms. Some of these colonies were very poor, and of course it was an unpopular thing to go to the public and say they must consent to an increase of taxation for their telegraph. Unfortunately Mr. Grosvenor's mission was very much prejudiced by the simultaneous offer—and probably intentionally so—of a very enterprising gentleman from the other side of the Atlantic, who at the very time that he was negotiating with these different colonies made very handsome offers, in case they got rid of the Company, to come in and do the work. The object of that gentleman was, of course, to destroy the Company and get hold of the Panama traffic, in which case he (the chairman) thought that the West Indian colonies would fare very badly. He did not think, however, that they would allow themselves to be wiped off the face of the earth, and they would not allow the gentleman referred to to get hold of the Panama traffic if they could help it. With regard to paragraphs 7 and 8 of the report, he could assure them that the information placed before them in paragraph 7 was dictated by no undue spirit of pride at what the present board had done. It was, however, necessary for those shareholders who had not been members of the Company long to think of what its condition was before they took it, and, therefore, they had stated very shortly what was the result of the operations of the Company before the administration of the present board. Previous to their taking office the shareholders had not received a single shilling of dividend, and it was the condition that the Company seemed to be in which caused the election of the present board. He regretted at the last meeting to hear certain reflections on the board, for he thought, however unfortunate their administration had been, they had the consolation of being an honest, and, as far as possible, an able board of directors; and it was not only because he was disappointed in that way, but also because the remarks which were made prejudiced their negotiations and position with the colonies. It was a very great thing for those who opposed the Company in the representative governments to say that the shareholders themselves accused the directors of mismanagement and extravagance. It was quite in the option of the shareholders to change the board, who were the servants of the shareholders, and if there was any serious desire for a change in the management he should offer no selfish opposition to it. He should however, be sorry to leave a leaky ship and to break his connection with his colleagues and the officers of the Company, who had always given him the most able and loyal support; but outside those considerations he should resign his position with very great equanimity. They thought, at the same time, that it was their bounden duty to support the constitution of the Company, and it was for that purpose that they had asked the shareholders for proxies, which he was glad to say had been forwarded to them in a satisfactory manner.

Mr. W. Ford having seconded the motion,

Mr. Robinson Kendal considered the directors were to be congratulated on the results of the past half year's working, and he thought the improvement was attributable to what the chairman had called the severe remarks made at the last meeting. He hoped that the day was not far distant when the shareholders might look for a happier state of things.

Mr. C. Robinson asked a question as to the amount recoverable for the "Investigator" from the underwriters, and whether there was any ground for a report that the undertaking of the Company was likely to be transferred to another company.

Mr. Griffith thought it satisfactory that the Company's legal advisers had succeeded in recovering £15,000 on account of the "Investigator," but they ought, at the same time, to remember the causes which had led to the loss of that vessel.

The Chairman, in reply, stated that three months before the last meeting, and therefore before Mr. Kendal was a shareholder, the reduction in the victualling scale which they are now working under was made. He repudiated the idea that there had been any increased activity on the part of the board since the last meeting, or any variation whatever in their procedure. There would be a settlement of accounts with the underwriters as to the "Investigator," but they would have about £300 or £400 more to receive. The variation in the amount they received from subsidies depended not on the number of messages they carried but on the working of the cables. Some of the colonies stopped their subsidies the moment an interruption in the system occurred, but others took a more lenient view. As a director of the Western and Brazilian Company, he knew that arrangements were now being made for the inspection of the Central American cable, with the view of restoring it by the Western and Brazilian Company, but whether it was restorable or not depended on what was found to be the state of the cable. Three days after the accident to the "Investigator" they engaged another ship, which at the time was in the Mediterranean, and in three months she was on the spot. They applied to all the colonies—French and Danish—which were the only colonies who subsidised them. They had made representations to the Home Government, from whom, however, they could get nothing. Breaks in the cables were not owing to any mismanagement on the part of the board—they occurred at the bottom of the sea, and were owing to friction on the rocks, of the existence of which they were ignorant. Some of the best cables in the world had failed within a month of being laid—the Madeira cable broke immediately, and the Atlantic cable, which was laid by Siemens, broke almost immediately it was laid. The repairs they had executed in the past six months had averaged forty-two days each. There was a report in New York that Mr. Jay Gould was anxious to buy the Company, but he had not put any proposal before the board. If he did wish to buy them they would treat him with every consideration.

Mr. Ford, in reply to a question by Mr. Griffith, thought it would be wrong at a public meeting to go into the causes of the accident to the "Investigator."

The report was then unanimously adopted.

On the motion of the Chairman, and seconded by Mr. Weaver, Sir James Anderson was re-elected a director, as was Mr. William Andrews, on the motion of the Chairman, seconded by Mr. Henry Holmes. The retiring auditor was also reappointed.

The Chairman, in reply to a vote of thanks to his colleagues and himself, assured them that they would do their best to place the undertaking in a more satisfactory position.

The proceedings then terminated.

LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY (LIMITED).

Report of the directors to be presented to the third ordinary meeting, on Monday, May 23rd, at 66, Old Broad-street:—The directors submit herewith the balance-sheet and other accounts for the past financial year, made up on the same principle as those last laid before the shareholders. The net revenue of the year, after providing for debenture interest and income-tax, and placing £1.000 to the reserve fund, is £10,652 11s. 2d., to this are added £6,4C6 11s. 9d. brought from the preceding year's account, and a special reserve of £1.384 12s. 8d., made in past years, and now reversed, making a total of £18,443 15s. 7d. to the credit of the revenue account. The interim dividend of two shillings and sixpence per share, paid on Nov. 1st, 1880, absorbed £4,793 10s., leaving now in hand £13,650 5s. 7d., from which the directors propose to appropriate £5,752 4s. in payment of a final dividend of three shillings per share, carrying forward £7,898 1s. 7d., pending the collection of the debt due from the Uruguay Government. The directors are pleased to observe that their anticipations of increased revenue have been realised during the twelve months now under review, and that the prospects of further increase are satisfactory. The Company's submarine cables and land lines are in good working order. The state of efficiency of the latter will be the better maintained by the stores and instruments sent out by the directors. Messrs. Deloitte, Dever, Griffiths, and Co., the auditors, retire at this meeting, but being eligible, offer themselves for re-election. Their remuneration will be fixed by the meeting. According to the Articles of Association John Hollocombe, Esq., a director of the Company, retires by rotation, and offers himself for re-election.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices May 18.		Business Done Week Ending May 18. Highest.		Lowest.	
Anglo-American	55⅛,	56¼	.....	56¼	.....	55⅞
Do. Preferred	86½,	87½	.....	87½	.....	87½
Do. Deferred	27½,	28¼	.....	28⅛	.....	28
Brazil Submarine	10¼,	¼	.....	10¼	.....	10⅛
Cuba	9,	⅛	.....	9¼	.....	9⅛
Do. Preference	16½,	17	.....	—	.....	—
Direct Spanish	3½,	4¼	.....	—	.....	—
Do. Preference	13.	14	.....	—	.....	—
Direct United States Cable	10⅞,	11¼	.....	11¼	.....	11
Eastern Telegraph	10,	¼	.....	10⅛	.....	10
Do. 6 per Cent. Preference	12¾,	13	.....	12⅞	.....	12⅛
Do. 5 per Cent. Debentures, 1899...	103,	105	.....	—	.....	—
Eastern Extension	11 1-16,	3-16	.....	11¼	.....	11
German Union	11⅛,	12½	.....	11⅛	.....	11⅛
Globe Telegraph and Trust Company.	6 5-16,	7-16	.....	6⅛	.....	6⅛
Do. Preference	12⅜,	⅝	.....	12⅛	.....	12⅛
Great Northern	12⅞,	13⅛	.....	13⅛	.....	12⅞
Indo-European	28,	29	.....	—	.....	—
Mediterranean Extension	2⅛,	⅜	.....	2⅛	.....	2⅛
Do. Preference	9¼,	10¼	.....	—	.....	—
Reuter's	11,	12	.....	—	.....	—
Submarine	270,	290	.....	—	.....	—
West India and Panama	2,	⅛	.....	2 3-16	.....	2⅛
Do. 1st Preference	7,	⅜	.....	7⅛	.....	7 3-16
Western Brazilian	8⅛,	⅛	.....	8⅛	.....	7 13-16
West. Union 7 per Cent. 1st Mortgage	120,	125	.....	—	.....	—
Do. 6 per Cent. Sterling Bonds	104,	108	.....	—	.....	—

THE EXCHANGE TELEGRAPH COMPANY
(LIMITED) (Established 1872).
Head Offices, 17 & 18, Cornhill, London, E.C.
AUTOMATIC TELEGRAPH INSTRUMENTS (Patented).
These Instruments are in daily use in the City and West End of London, at the offices of Brokers, Bankers, Merchants, and others, to record the constantly occurring fluctuations in the prices of Stocks and Shares, General Financial Intelligence, and the Special Telegraphic Advices received during the day, by the Company, from the Continental and American Stock Exchanges, &c.
They are also used under an agreement with this Company by
MAC-MAHON'S TELEGRAPHIC NEWS COMPANY, Limited (Established 1879),
for the delivery of Parliamentary, Sporting, and General News to the Press, Clubs, Hotels, Restaurants, Theatres, &c. &c.
Instruments for any of the above purposes can be obtained on application to the Secretary at the above address.
The Company is prepared to treat for the erection of single or double wire systems under the Company's patents, whereby from central stations identical information can be simultaneously delivered to any number of recipients by
Automatic, Self-Adjusting Printing Instruments.
These instruments require no local batteries, no winding up, and no knowledge of telegraphy on the part of the receiver, the printing and the propulsion of the paper being effected by the electricity supplied from the Central Office or Station.
The Company will undertake to supply instruments to work either on single or double wires, and print on a narrow slip of paper, as has hitherto been the custom with all recording instruments, and shortly by a recently-patented instrument by which the printing is done in column form on a broad band or sheet of paper.

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For terms apply to the Manager, 8, PICCADILLY, W.

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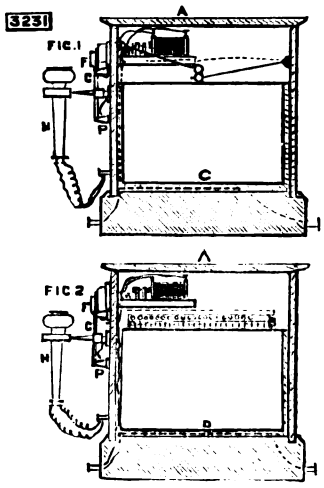
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

3231. IMPROVEMENTS IN TELEPHONIC APPARATUS, *H. L. Lake.—Dated 7th August*, 1880.—*(A communicotion from L. Maiche).* 6*d.*

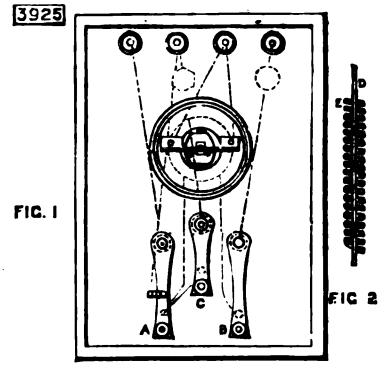
The object of the invention is to transmit sound over long distances by means of what the inventor calls electrophones. The apparatus is combined with the ordinary telephone, which serves as a receiving instrument, repeating at a distance all the sounds that have acted upon the electrophone. This latter consists of carbon contact pieces mounted upon a bell or sonorous box of (preferably) glass, the contact pieces being placed as near as possible to the edge of the box. These transform the sonorous vibrations of the substance of the sonorous box, in front of which the speaking is carried on, into mechanical action, and these vibrations produce differences of pressure between the carbons, and consequently variations in the intensity of the current, these variations in intensity produce induced currents in a (say Ruhmkorff) coil, and these induced currents are transmitted along the line to actuate the receiving



telephone. Fig. 1 shows the apparatus, and Fig 2 is a modification thereof. The space between the walls of the sonorous vessel and the wooden case A is filled with wadding. Upon the sonorous vessel C are placed the carbon contact pieces. A carries also a signalling stud, F, and movable lever, G, which supports telephone, H, and acts as a commutator. To attract the attention of anyone at the receiving station it is sufficient to press F. The telephone resting on its support overcomes the tension of the spring M, and causes contact between the terminal P and the lever G. The battery current then flows, the coil is in requisite condition for operating, the vibrator is thrown into rapid motion, and the induced currents rapidly repeated in the main wire act upon the telephone at the station communicated with, where a loud humming is heard, which is the call signal, thus dispensing with the usual electric bell.

3925. IMPROVEMENTS IN LIGHTNING CONDUCTORS, *S. Vyle.—Dated 28th September*, 1880. 6*d.*

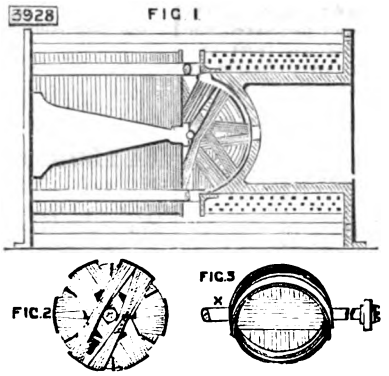
The conductors are constructed of copper, with an insulated wire set within the core of an outer cable, the top of the wire being soldered or otherwise metallically connected with the top of the outer cable, which latter is inserted in the ground; whilst the insulated wire is carried from the bottom of the outer cable to any suitable adjacent place above ground, and there connected with the key of a testing apparatus, which consists of a differential galvanometer, battery, switch, resistance coils, and connections. The back of the key connected to the testing wire may be earthed or not. To test the conductor, the key of the testing apparatus A is depressed when the galvanometer needle is deflected. Unless the continuity of the wire and cable be good no current will pass, and the needle will not be deflected. By disconnection at key B, which acts also as a switch, no current can pass through the other coil of the galvanometer, but on depressing B as well as A the current divides itself equally between the circuit formed by the insulated wire and outer cable, wire, or tube, and a resistance coil, which should be made exactly equal to the other circuit; this being so, any defect in the conductor would betray itself by the deflection of the needle. In this case an auxiliary key, C, is used, which when depressed at the same time as



B shows whether the earth of the conductor is good or whether the fault is above ground, as the current is then divided between B and C, whose resistances are equal. If right, the needle does not deflect. Fig. 1 shows the galvanometer, &c. Fig. 2 shows the conductor; D insulated wire set in outer cable, E.

3928. APPARATUS FOR GENERATING AND UTILISING ELECTRICITY, *W. R. Lake.—Dated 28th September*, 1880.—*(A communication from E. Thomson.)* 8*d.*

This invention refers to various modifications in the construction of magneto and dynamo-electric machines. The field magnet coils serve also the purpose of directly magnetising the iron in the armature. This is accomplished by a modification in the winding. Then the internal and external effects of the coils are both utilised, and



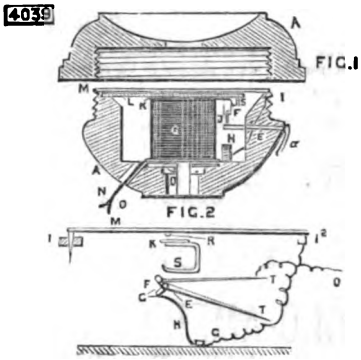
the insulated wire of the armature is at all times under the direct influence of the field magnets. Fig. 1 shows a side elevation, partly in section, of a machine; Figs. 2 and 3 show three coils of insulated wire as wound upon the armature, intersecting one another at the axis X at angles of approximately 60 deg.

3936. IMPROVEMENTS IN SHACKLE AND TERMINAL INSULATORS FOR TELEGRAPH WIRES, *J. W. Fletcher.—Dated 28th September*, 1880. 6*d.*

The inventor's insulator is similar as regards its lower portion to the No. 8 insulator, the upper portion is also similar, but inverted. so that the open end of the double cup is both upwards and downwards. It is formed of, preferably, one piece of earthenware, and is mounted on a vertical bolt passing through it and the upper and lower arms of the pole. The upper cups of the insulator being open at the top, are provided with drainage holes by which they empty themselves of rain water or dirt. The inventor also makes them with the ordinary mushroom head.

4039. IMPROVEMENTS APPLICABLE TO TELEPHONES FOR THE PURPOSES OF SIGNALLING, *J. G. Lorrain.—Dated 5th October*, 1880.—*(A communication from G. Trouve.)* 6*d.*

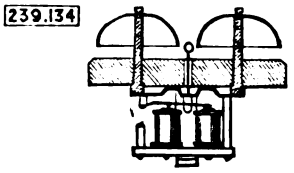
Figs. 1 and 2 show the apparatus in detail, Through one side of the case A passes a spindle. E, provided with pointer, *a*, and with two cams, F and G. E is kept always in communication with the line by means of the spring J, and the diaphragm is connected with a spring, H, screwed to the bottom of the recess provided for the coil C. E acts as a commutator. A small portion of the underside of M is scoured or scraped, and bears against three contact points, I, I^1, I^2, of copper set in the case A. I is connected with the wire passing from C; I^1 is perforated for the reception of a pin fixed to the diaphragm; and I^2 is in communication with H; N is a conducting wire connected with the pole of a battery and one of the poles of the coil; O is connected with the line wire and the spindle E by means of the spring



J, so that when G presses on H, the battery current through N passes through C, then through M, thence through H, G, and E, and lastly to J, which is connected to O. By moving *a* so as to bring it opposite C (call) marked on the outside of the telephone case, E is rotated and G is thereby moved away from H and the circuit is open. F is then brought into contact with a finger, S, carried by a spring lever, K, supported at L. This lever is raised by F and comes in contact with a projector, R, formed by a grain of platinum attached to M near the centre. The arrangement of E acting as a communicator, and also serving to cause the diaphragm to act with a tremulous motion, enables the contact points to be moved for as small a distance as may be desired, and to thus adjust the apparatus at pleasure.

239,134. SIGNALLING APPARATUS FOR DISTRICT TELEPHONE SYSTEMS, *George Lee Anders, Boston, Mass., assignor to American Bell Telephone Company, same place. — Filed August 7th*, 1880. *Patented in Canada, January 21st*, 1880; *in Belgium, June 15th*, 1880; *in Spain, October 20th*, 1880; *in Italy, July 30th*, 1880; *and in England, May 12th*, 1880.

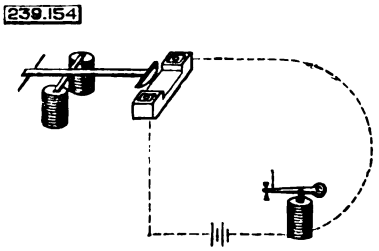
Claim.—In an electric circuit, two polarised electro-magnets for operating signal bells, the armatures of said magnets being normally held



by springs or their equivalents at poles opposite in relation to each other, substantially as and for the purposes set forth.

239,154. RELAY FOR TELEGRAPHS, *Thomas A. Edison, Menlo Park, N.J.—Filed December 14th*, 1880.

Claim.—The combination, with a local circuit and instruments therein, of a flexible high resist-



ance in such circuit, and a metallic contact resting therein and controlled by the main circuit, substantially as and for the purpose described.

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By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

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Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.

All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

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SLIP

THE TELEPHONE IN CALIFORNIA.—A telephone company has been incorporated at Los Angelos in California.

TELEGRAMS FOR CHILI.—Telegrams in code and cypher will now be accepted for transmission to Chili, Bolivia, and Peru.

PERSONAL.—Mr. G. P. Prescott, the well-known American electrician, is expected to arrive in England shortly from the United States.

TERRESTRIAL MAGNETISM.—The French Government are about to establish an observatory for terrestrial magnetism at Cape Horn.

EARTHQUAKES.—More shocks are reported from Austria. On the 26th of April and the 6th May shocks were felt in Carniola and Styria.

SWAN'S LAMP ON SHIPBOARD.—We hear that it is proposed to adopt Swan's electric light on board the Cunard steamship "Servia."

EXHIBITION OF INCANDESCENT LAMPS.—During the past week the systems respectively of Mr. Swan and Mr. Maxim have been shown in London.

MELBOURNE EXHIBITION.—Messrs. Theiler and Sons, of London, have obtained a first class award for electrical apparatus, &c., at this Exhibition.

ANOTHER NAME FOR PHOTOPHONY.—Mr. G. E. Cook suggests the use of the word *sonorescence* for the phenomena discovered by Graham Bell.

BRAZILIAN SUBMARINE COMPANY.—The traffic receipts of the Brazilian Submarine Telegraph Company (Limited) for the week ended 20th instant, amounted to £3,342.

THE WEST INDIES.—The Panama cable system has been completely repaired, and telegraphic communication is fully established between these islands and this country.

ELECTRIC LIGHT AT BOMBAY.—Some successful experiments with the electric light are reported to have been made on the Austro-Hungarian Lloyd's steamer "Daphne" at Bombay.

ORIENTAL TELEPHONE COMPANY.—The first ordinary general meeting of this company will be held on Friday, the 3rd June, at twelve o'clock, at the City Terminus Hotel, Cannon-street, E.C.

THE MESSINA-LEPARI CABLE.—This cable has just been laid, and messages have been exchanged. It was laid by the ss. "Chiltern," belonging to the Eastern Telegraph Company, for the Italian Government.

THE TELEPHONE IN ITALY.—The Anglo-Continental Telephone Company has received advice from its manager in Italy that the Italian Government has agreed to grant the Company concessions for all the principal cities.

PERSONAL.—We hear that the vacant seat in the New Zealand Ministry has been filled by Mr. W. W. Johnston, one of the leading merchants of Wellington. He has taken in hand the reins of the Postal and Telegraph Departments.

THE TELEPHONE IN NEW ZEALAND.—The telephone is being introduced by the Government in places where telegraph wires are not in existence. Between Collingwood and Motucka (a distance of 50 miles) a line has just been opened, and is said to work admirably.

WESTERN AND BRAZILIAN COMPANY.—The traffic receipts of this telegraph company for the week ended the 20th instant amounted to £2,275, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

ELECTRIC LIGHT AT CHATHAM.—The authorities have at last decided to use the Brush light to illuminate the large fitters' shop at Chatham Dockyard. There are seventeen lamps in all, said to be of 2,000 candles each. They are worked by an engine of 14 h.-p.

GERMAN WIRE TRADE.—The Osnabruck wire industry is reported to be very actively employed at present. Firms in the town have just received large orders for wire for South America, 800,000lb. of steel wire for the new Anglo-American cable, and 2,000,000lb., for the United States.

THE TELEPHONE AND THE FAIR SEX.—The introduction of the telephone by the Viceroy of Egypt into his palaces and harems has struck terror to the hearts of the fair occupants. They imagine that this is a dodge of his serenity to keep himself acquainted with all their tittle-tattle and doings.

A GASEOUS ECLIPSE.—*L'Electricité* says: "The electric light is not alone in its liability to sudden inexplicable eclipses. We read in the *American Gas Light Journal* of the 2nd May that, during the night of the 18th April, all the gas lights in the town of Selma (Alabama State) went out without warning.

TELEGRAPH EXTENSION IN SCOTLAND.—From Invergarry we hear that the telegraph wire is to be extended to Glenquoich Lodge, the residence of Mr. Bass, where it will be a great boon to the district, as the foot-post only goes to Glenquoich twice a week, and in winter once a week. Invergarry is, we believe, near Inverness.

THE NEW ATLANTIC CABLE.—We hear that ss. "Faraday" has successfully landed the shore end of the new Atlantic cable in Dover Bay, near Canso, Nova Scotia, and that those on board hope to lay the 1,000 miles of cable she has with her this week, after which she will buoy and return to England for the remaining portion.

SEISMOLOGY IN JAPAN.—The labours of the Seismological Society of Japan have established the fact that there is a chronic centre of disturbance within a radius of a few miles from Yokohama. We are glad we do not reside in the said Yokohama; at the same time, we congratulate the society on the success attending its researches.

INTERNATIONAL ELECTRICAL EXHIBITION.—The Commissioner-General begs exhibitors to be good enough to send in with the least possible delay the necessary facts for insertion in the catalogue of exhibits. These facts should be entered on the forms supplied to exhibitors by the Commissioner-General at the same time as their admission certificates.

VOLTA'S BATTERY.—To render Volta's battery constant and depolarised, Count Mocenigo fixes twelve couples with their elements on a horizontal axis, a trough of acidulated water having twelve compartments is then brought up by a lever motion so as to cover a good third of the surface of the batttery, and a rotatory movement is communicated to the axis.

LONG-DISTANCE TELEPHONING.—From America it is reported that the telephone has been worked between Bangor, Me., and St. John's, New Brunswick, a distance of 214 miles. Every word is said to have been heard distinctly. We also hear that Vicksburg is connected with New Orleans, a distance of 230 miles, and that conversation is carried on with much distinctness.

LEGAL.—The *Colonies and India* says, under the head of British Guiana:—"The Court of Policy decided, with only one dissentient, that it would only pay the subsidy to the West Indian and Panama Telegraph Company for 123 days in 1879, during which only the cables were in working order,

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and the company able to fulfil its contract with the Colonial Government." Is this true?

RADIOPHONY.—A correspondent, who modestly signs himself "Lunatic," asks us whether, if the latest explanations of photophony are correct, we ought to hear the sun's rays falling upon the moon, especially *if* they could be rendered intermittent by a whirling disc, and the sonorous vibrations collected here on this earth? We really cannot say. Looking at his signature we think our correspondent ought to know best.

DECOMPOSITION OF WATER.—In decomposing water by discharging Leyden jars through platinum electrodes, Dr. Streintz finds that, with very small electrodes giving passage to a series of discharge currents in one direction, and then left to themselves, a remarkable reversal of E. M. F. occurs, but only when the discharges do not exceed a certain number. Dr. Streintz made use of a quadrant-electrometer in his experiments.

LAW RELATING TO CABLES.—*L'Electricité* says that there is some idea of appointing a commission to inquire into the state of international law relating to submarine cables. The Minister for Foreign Affairs in France, M. St. Hilaire, has stated that, in case the forthcoming Congress of Electricians should arrive at any decision on the subject, he will send a circular to the various Governments suggesting the holding of an international conference.

ELECTRIC LIGHT FOR DURHAM.—The *Review of Gas and Water Engineering* of the 20th of May says:—"The sleepy inhabitants of Durham have been startled by a proposal to light the cathedral, the castle, and probably the college also, with the electric light. An eminent Newcastle engineer visited the town last week, and his report is that sufficient water can be easily obtained and the whole scheme completed at comparatively little cost."

E. M. F. OF INCONSTANT COUPLES.—From a study of the E. M. F. of inconstant couples, MM. Naccarè and Guglielmo conclude that, in couples containing one fluid, the E. M. F. is influenced by the nature of that pole to which the hydrogen goes, and that the change in the strength of the current varies always in the opposite sense to that of the E. M. F., the sense depending upon the manner in which the liberated oxygen enters into secondary chemical actions.—*Nature.*

A GLANCE INTO THE FUTURE.—"Professor Loomis appears still to be experimenting in aerial telegraphy—telegraphing without wires—and it is now said that he proposes to establish communication, through the current which he claims is always found at a great altitude, between one of the highest peaks of the Alps, in Switzerland, and a similarly situated station on the Rocky Mountains, on this continent." Such, according to the *Operator*, is the future that *loom's* before us!

THE ELECTRIC SCARE.—In his evidence before the Committee of the House of Commons on the South Metropolitan Gas Bill, Mr. G. T. Livesey, engineer to the South Metropolitan Gas Company, says:—"No doubt the 'electric scare,' as gas people call it, has materially affected the market value of gas companies' shares. In the case of the Gas Light and Coke Company, the £100 stock reached £210; but in consequence of the 'scare' it fell as low as £150, and is now £178."

ACCIDENT BY LIGHTNING.—A heavy thunderstorm passed over the south of Scotland on Wednesday afternoon. The lightning struck the Ardrossan New Railway Station, throwing the chimneys of the stationmaster's house through a glass roof over the station platform. The grate in the gentlemen's waiting room was thrown out of its place into the middle of the room, but no one was injured. The lightning also did damage to several wires in the postal telegraph office, rendering them unworkable.

ELECTRIC LIGHT ON THE EMBANKMENT.—The Société Generale d'Electricité have reduced their price for lighting the Victoria Embankment to $1\frac{1}{2}$d. per lamp per hour. This is the same price as is paid for gas. The charge originally was 6d. per hour, afterwards 5d., then 3d., and then $2\frac{1}{2}$d. It will be remembered that this Company are working the Jablochkoff system. If the above figures are the result of practical trial of the system, and represent the true state of affairs, they are highly encouraging.

ANOTHER ELECTRICAL SOCIETY.—We hear of the formation, at Frankfort-on-the-Maine, in Germany, of the Electrotechnische Gesellschaft. The first meeting of this society was held on the 10th March last under the presidency of Herr Heldberg, who is at the head of the Post Office. The members number fifty-one. Meetings will be held every month from October to May, inclusive. At the meeting in March Dr. Stein communicated a note on photographs recently obtained in Russia by means of the electric light.

UNDERGROUND WIRES IN PARIS.—The Municipal Council of this city are contemplating adding to their funds by taxing wires placed in the sewers. The proposed tax will be 20fr. per kilometre up to 500, 30fr. from 500 to 1,000, 40fr. from 1,000 to 1,500, and so on, with an increase of 10fr. for each 500 kilometres. *L'Electricité* says that the number of kilometres of wire placed in the sewers being about 7,000, the Compagnie des Téléphones will have to pay something like 59,500fr. It adds that the Company make no objection to this tax.

EARTHQUAKES.—A correspondent who spent some years in the Ionian Islands informs us, with reference to Mr. Forster's valuable and interesting letter published in our issue of the 14th inst., that Corfu enjoyed no exceptional immunity from the visitation of earthquake shocks while he was there. Our informant refers to a period just previous to the demolition of the fortifications; and, strangely enough, he was inside one of the forts—a *round* tower—when one such shock of earthquake was felt, which cracked the wall, some fourteen feet thick, from top to bottom.

OVERHEAD *v.* UNDERGROUND WIRES.—The Chicago Common Council has passed the following resolution:—"No person shall hereafter erect, construct, or put up, any telegraph pole, telegraph line, or wire, or electric conductor, in any street, avenue, or alley, within the corporate limits of the city of Chicago, under the penalty of 100 dollars for each and every offence. And each and every day any such telegraph pole, line or wire, or electric conductor shall be continued and maintained after the first conviction shall constitute a new and separate offence." This has rather disconcerted the telephone companies.

EDISONIA.—The *Brick, Tile, and Metal Review* of March last makes Mr. Edison speak as follows:—"There are 300 local Edison Electric Light companies organised in cities and towns in the United States, with ample capital, prepared to set to work as soon as I give the word 'ready;' and within three months 300 machine shops will be working exclusively on material for the Edison light. Each one of these companies will want to be supplied with lamps and machines by the parent company first, and preparations are now being made, under my personal supervision, for rushing the manufacture of those articles."

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TELEGRAPH WIRES IN NEW YORK.—A Bill just presented to the Senate at Albany enacts that all wires going in a northern or southern direction in that part of the town comprised between the Battery and Forty-two-street, shall be placed underground, or be carried on neat metal supports; that the companies shall begin to effect this change after the 1st July, 1881, and that it shall be completed by the 1st May, 1882; that after this latter date it shall be illegal to use wooden poles as supports for wires; and lastly, that the laying of wires shall be done under the direction of the Commissioner of Public Works.

ELECTRIC LIGHT IN LINCOLN.—Messrs. Robey and Co., engineers, of the Globe Works, have illuminated the spacious workshop devoted to the fitters, turners, and erectors, by the electric light on the Brush system. They have estimated that, reckoning the cost of the gas previously consumed at 2s. 8d. per 1,000 cubic feet, and after making full allowance for interest on capital outlay, depreciation, working expenses, and carbons, the electric light is slightly cheaper than gas for the same number of hours, and the new light has the very great advantage that it gives full and brilliant illumination of the whole shop, instead of the very partial lighting, with intervals of obscurity, formerly obtained with gas.

THE MUTUAL UNION COMPANY.—The directors of this telegraph company have resolved to fix the capital stock at 10,000,000 dols. The line from Boston, by way of Providence, New Haven, and New York, has been completed. It has also been decided to extend the line from Boston by way of Worcester, Springfield, Albany, Rochester, Buffalo, Cleveland, Toledo, Chicago, Milwaukee, St. Paul, Minneapolis, Kansas City, St. Louis, Indianapolis, Louisville, Cincinnatti, Columbus, and Pittsburgh. The Company's line to Washington has been completed, making a through connection from that city to Boston by way of New York. On the 2nd of May 1,500,000 dollars bonds out of a total issue of 5,000,000 dollars were offered for subscription.

LEGAL.—A motion for a new trial in the case of Christopher and another *v.* the United Kingdom Telegraph Company came on before Justices Lopes and Stephen on the 24th May. It is a good example of the intricacies of legal machinery, the original writ in the action dating as far as 1861. The question at issue was as to the invention of the uniform shilling rate for inland telegrams, the company that introduced it having been taken over by the Post Office in 1869. The executors of the inventor of the above rate, a Mr. Allan, who also promoted the company, made claim for moneys due to them from the Post Office under agreements. At the previous trial a verdict was given for the Post Office. The rule was discharged with costs.

SCARCE BOOKS.—A correspondent wishes to know if the following scarce books are in the Ronalds Library, and, if not, where he can refer to them:—"Diodorous Siculus on the Differential Galvanometer." "Electrical Effects of Silver on Railway Conductors" (communicated). "On the Preservation of the Bronchial Tubes by Electro-Plating":—a Suggestion by an M.D. "Magnetic Attraction of Blue Eyes in Female Operators." By T. S. Clark. Raleigh (Sir Walter): "Ane Newe Methode of Double Entry by Logarithms, with ane Original Invention for Speaking through ye Ocean." "Refutation of Above by Aristotle" (very scarce). "The Epic of Electricity: an Algebraical Poem." By W. E. A——n and J. P——y. 17 vols. 4to. "Supplement" to ditto. 9 vols.

AN ELECTRIC STORM.—Mr. F. C. Constable writes to *Nature*, under date Karachi, April 25, giving the following description of an electric storm which took place there on Monday, the 12th of April. He says:—"At 7 p.m., when I walked home, the blazing lightning leaving but momentary intervals of darkness, I heard all round me the constant crackling or rustling of blazing flames. Towards the north west across a low arc near the horison, pale sheet lightning swayed quickly to and fro. There was no rain at the time, that came heavily afterwards. The sound of flames was close round me, and others had the same experience. No one I can find has ever seen lightning so completely fill the air, or heard such strange sounds." Can any of our readers at foreign stations tell us of similar experiences?

FESTIVITY.—The Association Amicale des Postes et Télégraphes held a festive gathering in Paris recently, at which M. Cochery, Minister of Posts and Telegraphs, was present. Replying to the toast of his health, M. Cochery said he had found the association very useful to him in his official capacity, and he thought that the fusion of the two services had been greatly helped on by it. Preferring deeds to words, he concluded by drinking to the "Amicale." The treasurer stated that, although scarcely two years old, the society had a balance of 30,000 francs, and numbered more than a thousand members. Some attempt was made to ask a few questions of a disagreeable nature of M. Cochery, but this was quickly cried down by the main body of those present. The company did not separate till late.

RADIOPHONY.—At a meeting of the French Physical Society on the 1st of April last, M. Mercadier gave an account of his further researches in radiophony. He had studied the action of intermittent light on selenium, and was convinced that the effect produced was due to the light rays and not to the heat rays. The receivers in his experiment were formed of two thin strips of copper, separated by parchment. The strips were wound in a spiral form held tight by screws, and connected to the wires of a telephone. Their surfaces were filed and polished, heated over a Bunsen burner, and rubbed with a pencil of selenium. The receivers were exposed to the various colours of the spectrum, the intensity of the sounds produced was feeble for the blue, greatest for the yellow, and *nil* for all below red.

THE GRIEVANCES OF TELEGRAPH CLERKS.—Replying to questions in the House of Commons on Monday last, Mr. Fawcett stated, as announced in these columns last week, that he had already submitted to the Treasury certain preliminary proposals in reference to the position of the telegraph clerks. He admitted that it had occasionally happened that a telegraphist had remained on duty as long as twenty-one hours; but overtime of this character was usually volunteered. He was of opinion, however, that continuous duty for such long periods must be injurious both to the clerks themselves and to the interests of the public service, and in the proposals now under consideration the question of overtime would be dealt with in such a way as would, he hoped, prevent such excessive employment in future.

FAURE'S BATTERY.—One of these secondary batteries, by which electricity can be stored and kept for a length of time with little or no loss, was recently taken from Paris to Sir W. Thomson in Glasgow. In *Nature* for last week appears a letter from Sir William on the subject, dated the 17th May, which we reproduce. He says:—"I had the marvellous box under trial for seventy-two hours before I left Glasgow yesterday, giving it successive charges, and discharging to various degrees, measuring approximately the whole quantity sent in during the charge, and taken out in the discharge. Thus I shall be able to calculate the amount of energy spent, and the amount recovered under various conditions. Mr. J. T. Bottomley continues the trials in m

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absence. A considerable time must pass before I have results to publish."

THUNDERSTORM AT CANDAHAR.—A thunderstorm which broke over Candahar on April 6, says the *Homeward Mail*, is said to have been the most severe that has visited these parts for many years. It certainly was, from all accounts, most disastrous. From its commencement the lightning was very vivid, and the thunder continuous in its roll for some hours. The hailstorm with which the tempest commenced caught a large flock of sheep belonging to the Commissariat grazing near the hills, and killed several of them, and the remainder set off in a stampede towards the citadel. A number of the animals (about seventy) were so injured by the hail that they had to be killed at once. The horses of the Artillery were standing in two feet of water all night, and the 1st Beluchees have been washed out of house and home.

AN ELECTRICAL 'BUS AT BERLIN.—An omnibus run by electricity is announced to ply between Zehlendorf and Teltow at Berlin. The authorities have granted permission for the erection of the necessary apparatus, which consists of a conducting wire, on which runs the electrical apparatus, this being connected with the omnibus by means of a thin chain. The vehicle is similar to a four-wheeled 'bus, with room for ten people. A guiding wheel is placed in front. Between the hind wheels is placed the driving apparatus, which is connected by a thin chain with the electrical apparatus. Two strong, endless chains run from the driving apparatus to each of the hind wheels, and cause them to revolve. It is calculated that this 'bus will do the distance between Zehlendorf and Teltow in twelve and a-half minutes. The distance is four kilometres.

ELECTRICITY ON THE STAGE.—A correspondent, who refuses his name and address, sends us the following, but won't say where he got it from:—"The electric light is now used at the New York theatres to produce various new and startling effects. It is applied to the incantation scene in 'The Black Crook' at Niblo's, for instance, with curious results. It flames from the eyeless sockets of the necromancer's skull, crackles along the dead branches of skeleton trees, and floods the whole stage with unearthly brilliancy. In the duel scene electric wires run through the handles of the swords of the combatants, and when the blades meet a circuit is completed and flashes of lightning play around the weapons in most diabolical fashion. This is probably the first time that electricity has been so systematically applied to stage purposes."

WHAT'S IN A NAME?—It is seldom that even scientific names will bear close examination, but it rarely happens that they lead to such misapprehension as has arisen in relation to Mr. Graham Bell's so-called photophone. It now appears by the extract, published in our last issue, from his original announcement, that he never supposed the sonorous effects were due to light—that is, to the merely luminous rays of light. Mr. Bell may console himself with the reflection that "microphone," "thermophone," and all the rest of the phones, which have been accepted without serious question, are terms that might be equally misleading if their practical convenience did not outweigh their verbal inexactness. Photophone, after all, is as good a name as could be found for Mr. Bell's invention, although the field of investigation to which it has given rise may be more properly designated radiophony.

INVERSE E.M.F. OF THE VOLTAIC ARC.—M. Jamin points out in a recent note to the French Academy of Sciences that the voltaic arc produced by a battery or accumulator of electricity is obtained under worse conditions than that produced by means of a dynamo-electric machine. In fact, this inverse E.M.F., which may be represented by that of 10 to 15 Bunsen cells, annihilates a force equal to the whole E.M.F. supplied by the battery; whilst in induction machines this inverse E.M.F. acts in the same manner as the E.M.F. developed by the machine at each alternation of the current, and only produces contrary effects at the moment when the current produced is on the point of being annulled; thus the E.M F. obtained is swelled by that of the arc, which thus becomes of use. M. Jamin says that with the latest improvements in the Gramme machine 15 to 20 lamps can be lighted in the same circuit, giving 60 to 80 per machine, each of these lamps being of about 25 Carcel burner power. *La Lumière Electrique* says that according to these figures we should have a total of 1,500 to 2,000 Carcels with about 20 horse-power.

ELECTRIC LIGHT FOR COAL MINES.—At a meeting of the North of England Institute of Mining and Mechanical Engineers, at Newcastle, on Saturday, the 14th May, Mr. Swan exhibited his lamp as adapted for mining purposes. He said that "when he began to produce an economic electric light, his intention was simply to produce an electric lamp which would be generally applicable; but several persons, whose opinions he could not but respect, represented to him that the lamp, in a suitable form, might be used for lighting coal mines; and these strongly expressed opinions had led him to put the lamp in the shape in which it would have to be for this purpose; and the ultimate result was the form of lamp which he exhibited. This would be quite safe in a dangerous atmosphere, on condition that the glass did not break, and that there was no accidental breakage of the wires. Care would also have to be taken in detaching the wires. He was having fifty lamps made. These would be placed in the hands of the members of the Accidents in Mines Commission, and tried at a colliery in Nottinghamshire, and elsewhere for lighting pit heaps; but as a safety lamp they would be tested in a laboratory by Professor Abel.

ELECTRIC LIGHT FOR LAMBETH.—The Lambeth Vestry some time since appointed a committee to enquire into the best means of lighting part of the parish by electricity. The committee have recently given in their report, which is substantially as follows:—It would appear that application was made on January 7th to the Société Generale d'Eclairage Electrique for an estimate for lighting on their system the Waterloo-road, from the bridge to the South-Western Railway station. The company replied that they were not in a position to entertain the matter, and therefore declined. The Brush Company were next asked to tender for lighting that portion of the main road from Westminster Bridge to the Horns Tavern, Kennington. They have replied, however, that they are not prepared to enter into a contract to do this, but that the company have the question of street lighting under consideration, and hope to arrive at a definite conclusion on the subject before long. The committee finally turned to Messrs. Siemens Brothers, who gave an estimate for lighting the road from Westminster Bridge to Kennington Park, as follows:—Outlay for plant, about £4,000; production of the light, about £1,694 per annum. The present lighting by gas is estimated to be from £450 to £500 per annum. At the meeting of the vestry, at which the above report was presented, a gentleman stated that he had an estimate from Messrs. Siemens to light Westminster Bridge-road for £2,000 per annum. After a somewhat amusing discussion, the vestry came to the conclusion that the matter had better rest for the present, until the results of the lighting in the City had been fully ascertained.

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CORRESPONDENCE.

"THE PERTURBATIONS OF TELEPHONY."

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The article in your issue of the 14th inst. under the above heading is exceedingly interesting, pointing out as it does some of the causes which may produce disturbances in the telephone circuits, which have hitherto been attributed to induction; but some of the statements made in this article are so unpractical, while professing to deal with practical telephony, that a few comments may not be out of place in your valuable journal.

M. Gaiffe finds that the rubbing together of two wires, or the friction of a binding screw connecting two wires, produces a noise in the telephone, and then comes the following :—

"It can readily be understood that when aerial telegraph lines serve for telephonic transmission, the first cause will be sufficient to generate disturbances, since these lines are formed of wires jointed with screws, and more or less imperfect ligatures, which are in a continual state of agitation. But this cause of non-success could be overcome by replacing these simple ligatures by soldered joints."

I may ask whether any of your readers know where aerial lines jointed with screws, &c., are to be found, and whether the method of joining wires by means of soldered joints is quite a new idea?

Unfortunately, although no engineer would intentionally construct a line with unsoldered joints, yet these do occur by oversight or carelessness, and are the cause of some very ugly noises, usually attributed to induction.

M. Gaiffe finds that the mechanical vibrations of a strip of iron placed in the circuit produce sounds in the telephone, and he surmises that the shaking of the wires with the wind will produce the same effect, and on a long line will tend to obliterate the "vocal currents." As a remedy for this it is naïvely suggested that as "underground wires are, of course, free from the shaking of the wind, and have other 'advantages in their favour,' they might be substituted for aerial lines," and also that the wire should be of some non-magnetic metal—"copper might be employed if it were stronger, brass would answer better, but manganese bronze would probably succeed best of all." The question of underground *versus* overhead wires would occupy too much space in this letter; but with regard to general principles of construction we may take it for granted that, so long as galvanised iron wire remains the best for overhead work, it will be used alike for the telegraph and the telephone. And the same may be said of almost every detail of construction.

No doubt it is of great importance to those engaged in practical telephony to know that such causes of disturbance as M. Gaiffe has discovered do exist, and to be able to distinguish between disturbances caused by them, by induction, or by faults in the line or apparatus. I very much doubt, however, whether such causes as molecular or mechanical strain, the oscillation of the wire, &c., will produce any appreciable disturbance even on the longest lines. We must look much nearer home for the causes which at present seriously interfere with the practical application of the telephone.

However desirable it may be, theoretically, to have a perfectly silent telephone circuit, so far as regards unintentional sounds, yet such is by no means a necessity. Experience shows that when once the ear has become accustomed to extraneous noises in the telephone it ceases to notice them. I have had to do with with some long lines on which the "induction" was very heavy. Three of these were respectively 50, 22, and 17 miles, yet they were in constant use with the telephone, which successfully replaced the Wheatstone A B C instrument.

There is no doubt that more than half the disturbances usually attributed to induction are due to other causes. At least 50 per cent. is due simply to leakage. It is well known that the telephone will respond to the most minute currents; and even on a short line insulated in the usual way the leakage is quite sufficient to account for one half of the sounds usually attributed to induction. The best method of obviating this is to convey the leakage to earth by means of a perfect system of earth wires at every support.

As a matter of fact, however, the telephone lines which have been erected in this country and elsewhere in connection with the system of exchanges which have sprung up so rapidly have been constructed exactly as ordinary telegraph lines, no precautions having been taken in dealing with such an exceedingly sensitive instrument as the telephone. Induction is the great difficulty which must be overcome before we can have very long lines or underground wires; but, setting aside those disturbances which arise solely from induction, I think it will be found quite practical to make the telephone an unlimited success without departing very widely from those details of mechanical construction which long experience has shown to be the best for telegraphic purposes.—Yours, &c.,

W. KINGSLAND.

THE CONSERVATION OF ELECTRICITY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: By the kind permission of Messrs. Macmillan and Co. I am allowed to quote the following paragraph from the preface to my "Elementary Lessons in Electricity and Magnetism," shortly to be published by them in their School Class Books Series, and now in the press. The preface is dated "March 1881."

"The theory of electricity adopted throughout is that electricity, whatever its nature, is *one*, not *two*. That this electricity, whatever it may prove to be, is not *matter*, and is not *energy*; that it resembles both matter and energy in one respect, however, in that it can neither be created nor destroyed. The doctrine of the *Conservation of Matter*, established a century ago by Lavoisier, teaches us that we can neither destroy nor create matter, though we can alter its distribution and its forms and combinations in innumerable ways. The doctrine of the *Conservation of Energy* which has been built up by Helmholtz, Thomson, Joule, and Mayer during the last half century teaches us that we can neither create nor destroy energy, though we may change it from one form to another, causing it to appear as the energy of moving bodies, as the energy of heat, or as the static energy of a body which has been lifted against gravity or some other attracting force into a position whence it can run down, and where it has the potentiality of doing work. So, also, the doctrine of the *Conservation of Electricity*, which now is growing into shape,* but here first enunciated under this name, teaches us that we can neither create nor destroy electricity, though we may alter its distribution—may make *more* to appear at one place and *less* at another—may change it from the condition of rest to that of motion, or may cause it to spin round in whirlpools or vortices which themselves can attract or repel other vortices. According to this view all our electrical machines and batteries are merely instruments for altering the distribution of electricity by moving some of it from one place to another, or for causing electricity when heaped up in one place to do work in returning to its former level distribution. Throughout these lessons the attempt has been made to state the facts of the science in language consonant with this view; but rather to lead the young student to this as the result of his study than to insist upon it dogmatically at the outset."

The above paragraph is published at the present time because, since the date when my manuscript was sent to the publishers, a memoir has been presented to the *Académie des Sciences* bearing the title "*Sur le principe de la conservation de l'électricité, ou second principe de la théorie des phénomènes électriques.*" Of this memoir, which is by Mons. G. Lippmann, only a brief extract has as yet been published in the *Comptes Rendus* of the sitting of May 2nd, when it was read. In that short extract the general doctrine of the conservation of electricity is laid down with considerable clearness, and an elegant analytical expression of it is given in the briefest form, the author promising some examples of its application to the prediction of new and important phenomena. The publication of the complete memoir of M. Lippmann will, no doubt, be awaited with interest.

As my manuscript was placed in the hands of Messrs. Macmillan and Co. on the very day when the above extract was written, the phraseology used by M. Lippmann must have been adopted by him in entire independence of me. Since some weeks must elapse before my "Elementary Lessons" will be in the hands of the public. I wish to avoid, meantime, all chance of misunderstanding by taking the earliest opportunity, firstly, of making this acknowledgment, which is due to M. Lippmann; and, secondly, of establishing my right to use the language of my preface as to the explicit enunciation of *the doctrine of the Conservation of Electricity*.—Yours, &c.,

SILVANUS P. THOMPSON.

University College, Bristol, May 19th, 1881.

ELECTRIC CIRCUITS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: One of the most difficult problems which the electric engineer of the present day has to solve is the varying of the tension of the main wire of an electric circuit to suit varying work. The writer has made experimental trial, with satisfactory

* This is undoubtedly the outcome of the ideas of Maxwell and of Faraday as to the nature of electricity. It has nowhere been more excellently or pithily put into shape than in a discourse delivered by Dr. Oliver J. Lodge, before the London Institution, "On the Relation between Light and Electricity," Dec. 10, 1880.

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results, of what he believes to be a novel method of accomplishing this. The method is particularly adapted for circuits, with lamps in series, or in derived circuits.

The inducing electro-magnets of the dynamo machine have pole pieces movable on racks. Their form is such that, although closely embraced by the magnets, they are easily moved. A heavy needle, balanced between the directive force of the earth and of a part of the circuit (or other similar contrivance), deviates to the right or left, as, through the lighting or extinguishing of lamps, the total resistance, and, therefore, current, diminishes or increases. Upon the direction of this deviation of the needle depends the direction of the instantaneous current in a derived circuit closed by the movement of the needle or other apparatus. This current is sent through two opposed electro-magnets; in the same direction through both when the needle turns—say, to the right, and in the opposite direction when the needle goes to the left. We have thus a power which by any simple mechanism can cause the pole pieces of the dynamo-machine to approach or recede from the bobbin tooth by tooth till the amount of current passing at a given point in the circuit comes again to the normal standard.

Another form of the apparatus is an adaptation of the ordinary sliding keeper of the medical machines. In a third the number of turns of wire in the coils of the inducing magnets through which the current flows is added to or diminished. I should like to hear the opinion of others on these methods.—Yours, &c.,

JNO. M. M. MUNRO.

ELECTRIC LIGHTING IN COAL MINES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Having seen an extract from *The Electrician* stating that the Swan Electric Light was to be laid on to Mr. John Watson's Earnock Colliery at Motherwell, and being somewhat interested in this matter, I should like to know if you or any of your readers can kindly inform me whether this has been done, to what extent, and with what success. I am especially anxious to know if the light is in use at the miners' working places. Thanking you in prospect, I am, yours &c.,

AN INTERESTED ONE.

MOLECULAR MAGNETISM.*

BY PROFESSOR D. E. HUGHES, F.R.S.

During the course of some late researches, which I had the honour to communicate to the Royal Society, March 7th,† and experimentally illustrate on the reading of my second paper, March 31,‡ so many experimental facts occurred, all pointing to the conclusion that ordinary molar magnetism is entirely due to the symmetrical arrangement of its polarised molecules, and that these molecules can be rotated by torsion, so as to decrease its longitudinal magnetism, or increase it if the effect of the elastic torsion is to rotate the molecules in its required longitudinal symmetrical arrangement, and observing that molecular magnetism could induce an electric current upon its own molar constituents, or that an electric current by its passage through an iron wire would produce molecular magnetism, I have continued these researches in the hope of elucidating, as far as possible, the phenomenon of the transformation of electricity and magnetism by the changes produced in the molecular structure of its conducting wire.

For this purpose I have employed three separate methods of investigation, each requiring a slightly modified form of apparatus. The first relates to the influence of an elastic torsion upon a magnetic or conducting wire; the second the influence upon the molecular structure of an iron wire by electricity or magnetism; the third was the evident movement of the molecules themselves as given out in sonorous vibrations.

The general details of the apparatus employed having been given in my paper of March 7th, I will only briefly indicate any modification of the method employed.

1. INFLUENCE OF AN ELASTIC TORSION UPON A MAGNETIC OR AN ELECTRIC CONDUCTING WIRE.

In my paper of March 7th, "On Molecular Electro-Magnetic Induction," I showed that induced currents of electricity would be induced in an iron wire placed on the axis of a coil through which intermittent currents were passing, and that these currents were produced only when the wire was under the influence of a torsion not passing its limit of elasticity. It became evident that if the intermittent magnetism induced by the coil produced under torsion intermittent currents of electricity, that an intermittent torsion under the influence of a constant current of electricity or a constant magnetic field would produce similar currents. This was found to be the case, and as some new phenomena presented themselves indicating clearly the molecular nature of the actions, I will describe a few of them directly relating to the subject of this paper.

The apparatus used was similar to that described in my paper of March 7th. An iron wire of 20 centims. was placed in the centre or axis of a coil of silk-covered copper wire, the exterior diameter of the coil being 5½ centims., having an interior vacant circular space of 3½ centims. The iron wire is fastened to a support at one end, the other passing through a guide, to keep it parallel but free, so that any required torsion may be given to the wire by means of a connecting arm or index. A sensitive telephone is in direct communication with the coil, or a galvanometer may be used, as the currents obtained by a slow elastic torsion are slow and strong enough to be seen on a very ordinary galvanometer. I prefer, however, the telephone, because it has the inestimable advantage in these experiments of giving the exact time of the commencement or finish of an electric current. It has, however, the disadvantage of not indicating the force or direction of the current; but by means of the sonometer the true value and direction of any current is at once given. Again, the telephone is useless for currents of slow intermittence, but by joining to it the microphonic rheostat described in my paper of March 7th a slowly intermittent or permanent current is broken up into rapid intermittent currents, and then we are able to perceive feeble constant currents. For this reason a microphonic rheostat is joined to the telephone and coil. The current from a battery of two bichromate cells is sent constantly through the wire if we wish to observe the influence of the torsion of the wire upon the electric current, or a constant field of magnetic energy is given to the wire by either a separate coil or a permanent magnet. The currents obtained in the coil are induced from the change in the molecular magnetism of the wire, but we may equally obtain these currents on the wire itself without any coil by joining the telephone and rheotome direct to the wire; in the latter case it is preferable to join the wire to the primary of a small induction coil, and the telephone and rheotome upon the secondary, as then the rheotome does not interrupt the constant electric current passing through the wire. As the results are identical, I prefer to place the telephone on the coil first named, as the tones are louder and entirely free from errors of experimentation.

If we place a copper wire in the axis of the coil we produce no effect by torsion, either when under the influence of a constant magnetic field or a current passing through it, nor do we perceive any effects if we place an iron wire (2 millims. in diameter), entirely free from magnetism, and through which an electric current has never passed. I mention this negative experiment in order to prove that all the effects I shall mention are obtained only through the magnetism of the wire. If now I pass an electric current for an instant through this same wire, its molecules are instantly polarised, and I have never yet been able to restore the wire to its original condition, and the magnetisation induced by the passage of a current is far more powerful and more persistent in soft iron than tempered steel. This may be due, however, to the fact that in tempered or softened steel we find traces only of a current due to the rotation by torsion of its molecules some two to three degrees of sonometer, whilst iron gives constantly a current of 70 sonometric degrees.*

In order to obtain these currents, we must give a slight torsion of 5 or 10 degrees to or fro between its zero point. We then have a current during the motion of the index to the right, and a contrary current in moving the index to the left. If we use a galvanometer, we must time these movements with the oscillations of the needle; but with the telephone it gives out continuous sounds for either movement, the interruptions being only those caused by the rheotome. The direction of the current has no influence on the result; either positive to the free arm or index or negative gives equal sounds, but at the moment of reversal of the current a peculiar loud click is heard, due to the rapid change or rotation of the polarisation of its molecules, and this peculiarly loud momentary click is heard equally as well in steel as in iron, proving that it is equally polarised by the current, but that its molecular rigidity prevents rotation by torsion. We can imitate in some degree the rigidity of steel by giving the iron wire several permanent twists. The current due to elastic torsion is then reduced from 70 degrees to 40 degrees, due to the mechanical strain of the twists remaining

* Abstract of Paper read before the Royal Society.

† "Molecular Electro-Magnetic Induction," *v.* p. 232, Vol. VI.

‡ "Permanent Molecular Torsion of Conducting Wires produced by the Passage of an Electric Current," *v.* p. 257, Vol. VI.

* 0·8 of a Daniell battery.

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a constant; and a weakening of the current is also remarked if with a fresh wire we pass in torsion its limit of elasticity.

If a new soft iron wire of 2 millims. (giving no traces of a current by torsion) has passed through it a momentary current of electricity, and then wire observed free from the current itself, it will be found to be almost as strongly polarised as when the current was constantly on, giving by torsion a constant of 50 sonometric degrees. If, instead of passing a current through this new wire, I magnetise it strongly by a permanent magnet or coil, the longitudinal magnetism gives also 70 degrees of current for the first torsion, but weakens rapidly, so that in a few contrary torsions only traces of a current remain, and we find also its longitudinal magnetism almost entirely dissipated. Thus there is this remarkable difference, and it is that whilst it is almost impossible to free the wire from the influence produced by a current, the longitudinal magnetism yields at once to a few torsions. We may, however, transform the ring or transversal magnetism into longitudinal magnetism by strongly magnetising the wire after a current has passed through it. This has had the effect of rotating the whole of the molecules, and they are all now symmetrical with longitudinal magnetism. Then by a few torsions the wire is almost as free as a new wire, and I have found this method more efficacious than heating the wire red hot or any other method ye tried. If I desire a constant current from longitudinal magnetism I place at one of the extremities of the wire a large permanent magnet whose sustaining power is 5 kilometres, and this keeps the wire constantly charged, resembling in some respects the effects of a constant current. The molecular magnetism or the current obtained by torsion is not so powerful from this, my strongest magnet, as that produced by the simple passage of a current, being only 50 sonometric degrees in place of 70 degrees for that due to the passage of a current. The mere twisting of a longitudinal magnet, without regard to the rotation of its molecule having no effect, is proved by giving torsion to a steel wire strongly magnetised, when only traces of a current will be seen—perhaps one or two degrees—and a constant source of magnetism or electricity then giving no measurable effect. Evidently we have equally twisted the magnetised steel as the soft iron. In the steel we have a powerful magnet, in the soft iron a very feeble one; still, the molecular rotation in iron produces powerful currents to the almost absolute zero of tempered steel.†

If we magnetise the wire whilst the current is passing, and keep the wire constantly charged with both magnetism and electricity, the currents are at once diminished from 70 degrees to 30 degrees. We have here two distinct magnetic polarisations at right angles to each other, and no matter what pole of the magnet or of the current, the effect is greatly diminished. The rotation of the two polarities would now require a far greater arc than previously. The importance of this experiment cannot as yet be appreciated until we learn of the great molecular change which has really occurred, and which we observe here by simply diminished effects.

If we heat the wire with a spirit flame, we find the sounds increase rapidly from 70 to 90, being the maximum slightly below red heat. I have already remarked in my previous paper this increased molecular activity due to heat and its effects will be more clearly demonstrated when we deal with the sounds produced by intermittent currents.

Another method, by means of which I have again received proofs of the rotation of the polarised molecule, is to pass an intermittent current through a soft 0·5 millim. iron wire, listening to the results by the telephone joined direct and alone to the coil, as described in my paper of March 7. If, then, the wire is entirely free from strain, we have silence, but a torsion of 20 degrees produces some 50 sonometric degrees of electric force. If, now (the wire being at zero strain), I bring one pole of the permanent magnet I have already described near the side of the wire, the sounds increase from zero up to 50 degrees, being at their maximum when this magnet is 5 centims. distant; but if we continue to approach the magnet the sounds gradually weaken to an almost zero. The explanation of this fact can be found when we know that the greatest inductive effect on the wire would be when a magnet is at an angle of 45 degrees with the wire. And, also, considering each molecule as a separate independent magnet, we find that at a given distance for a given magnet the force of rotation is equal to that of 45 degrees; by approaching the magnet we increase the rotation but diminish the angular polarity in relation to the wire, hence the decrease of force by the near approach of the magnet. And to prove that the function of the elastic torsion is simply to rotate the polarised molecules similarly to the magnet, we place the wire under an electric torsion of 20 degrees, and approach gradually the magnet as before. One pole now will be found to increase the sounds or its angular polarity, the other will decrease until at 5 centims. distance as before we have perfect silence. The torsion exists as before, but the molecules are no longer at the same angle. On removing the magnet we find that instead of the usual 50 of current we obtain barely 5 or 10. Have we, then, destroyed the polarity of the molecules, or do they find a certain resistance to their free rotation to their usual place? To solve this question we have only to shake or give the wire a slight mechanical vibration, and then instantly the molecules rotate more freely, and we at once find our original current of 50 degrees. I will forbear mentioning many other experimental proofs of my views by this method, as there are many to relate by different methods in the following chapters.

(TO BE CONTINUED.)

† I purposely avoid using the terms "magnetic fluid" and "coercitive force."

THE ELECTRO-TECHNICAL SOCIETY OF BERLIN.

At the last meeting of this society copies were shown of a very interesting reprint of a lecture delivered by Dr. C. A. Steinheil, August 25, 1838, at Munich, upon "Telegraphy, Especially by Galvanic Means." In this lecture a description was given of the galvano-magnetic telegraph invented by Professor Steinheil, and employed in 1837 between Munich and Bogenhausen. A model of this interesting form of telegraph was recently placed in the museum at the Imperial Post Office at Berlin. With reference to the conduction of the electric current back again through the earth, a discovery which was also made independently by Dr. Steinheil, the following statement is found in the lecture:—"We have already mentioned that Ampère required more than sixty connections, while Sömmering was content with about thirty. Wheatstone and Cooke reduced the number to five, while Gauss and probably after him Schilling brought the number down to one. This it would seem was the final limit in the simplification of the apparatus. Such, however, was not the case. I have found that one half of the chain may be dispensed with, inasmuch under certain conditions the ground itself replaces the other half."

The next business was the description given by Herr Hefner-Alteneck of a new dynamo electric machine, of which the speaker showed the original model, together with a number of drawings and illustrations. In its form it resembles the so-called alternating current machine of Siemens and Halske, to which it presents a further similarity in the mode of origin or production of the separate induction currents, but from which it differs in the fact that it produces a continuous current of electricity. This was followed by an interesting description and exhibition of a clock which could wind itself up and be kept going for six months by electricity without changing the battery. Another important communication referred to the revolution which had been introduced into the manufacture of pianofortes by a novel application of electricity. The wood, and especially the sounding-boards employed in the manufacture of those instruments, may be so prepared by the use of electricity that they are able to withstand the influence of all changes of temperature, while at the same time the tone of the instrument is very materially improved both in quality and power, so that it is found superior to any others hitherto manufactured. It has often been observed that the quality of the tone of the violins of the old Italian masters improves with age, while in the case of pianofortes the opposite is the case. The difference attributed to some hitherto unknown property in the sounding boards. M. Rene, of Stettin, observed boards which for years had been exposed to the action of the atmosphere, and, therefore, to the influence of oxygen, were better adapted, and having others for the manufacture of pianos and other musical instruments. Pursuing this idea, he made a practical application of it by ozonizing the wood, subjecting it to the action of heated oxygen with the help of electricity. He has employed the boards thus prepared in the manufacture of pianos, and the result has invariably proved a striking success.

LONDON-PLATINO-BRAZILIAN TELEGRAPH COMPANY.—The shareholders of this Company must have heard with pleasure the speech of the chairman, Mr. J. Pender, M.P., at the recent meeting, and his expression of hope that the future looked more favourable than the past had been. There are few men more able to obtain a correct forecast of cable work than Mr. Pender, and we are quite sure his remark concerning the international character of cable interests will commend itself to every one interested. One other notable feature in this meeting is the care taken to show that whilst a company must necessarily consult its own interests in the first place, it considers also the interests of its neighbours.

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THE OHM.

In the not very distant future, when electricity will be the maid-of-all-work to all civilising agencies, when by means of it all lighting and heating and the driving of machinery, all speaking and seeing, and possibly all warfare, will be carried on, the *dilettantes* of the time will no doubt quarrel mightily as to the date of the beginning of the new era. We cannot say what will be the conclusion to which they will come, for between us and them there may be some gigantic discovery which will altogether hide from them our insignificant triflings with the mysteries of nature. But should there be no sudden discontinuity in the progress of science we feel that of all dates, with the exception of that of Joule's equivalent, which may, perhaps, appear even more important to our posterity, the most significant is the date of the publication of the Ohm by a committee of the British Association.

It is impossible for us to think of our ancestors when they were utterly unacquainted with notions of length, of mass, and of time, as we should have to go back to the ancestors of Silurian Trilobites, but it is in no way difficult to conceive of human beings unacquainted with notions of resistance, quantity of electricity, difference of potential and electromotive force. We do not lay much stress upon a difficulty about nomenclature. Men may speak of "intensity" and "quantity" currents, and so long as they have clear ideas as to what they mean we cannot complain, albeit, we wonder why they use terms which perpetuate the necessity for endless riddle-solving. But far beyond this, there are still in existence men who have constantly to deal with electrical instruments and machines, to whom a current of a milliweber and a current of a Weber are really the same, although one is one million times larger than the other. It is not difficult even now to imagine this state of mind, but when we reflect on the fact that twenty years ago it was the state of mind of most of the men who gave popular lectures and wrote books on physics, and who thought they had a knowledge of electricity, we begin to see that in these twenty years something must have occurred of a most important kind for the enlightenment of electricians. The general introduction of the Ohm in boxes of resistance coils ("a unit" the wise it call, if they speak to workmen), into all places where electrical experiments are made, has been the wonder-working agent, the great cause why nebulosity no longer reigns supreme in the councils of electricians. We say no longer reigns "supreme," for it still reigns in some peculiar way, and every now and then seizes upon the minds of men, and carries them to the oddest of results (a chemical theory of the voltaic cell, which is not the same as Thomson's contact theory, for example). Still, a great change has been wrought; our notions on the subject of electricity are no longer without form and void in the darkness.

A British Association committee has been reappointed for the remeasurement of the Ohm, and of other units. It is not to their work, however, that we wish now to draw attention, but rather to a good stroke in the right direction, done in the Cavendish laboratory by Lord Rayleigh with the assistance of Dr. Schuster and others. The old British Association apparatus has been fitted up again, with such improvements as the criticism of nearly twenty years has suggested. It will be remembered that this is the only method in which the measurement of transient currents by ballistic galvanometers is not employed. A circular coil of insulated wire forming a closed circuit rotates about a vertical axis, and the electrical current induced in it by the earth's magnetism gives a steady deflection to a magnetic needle at its centre. The manifold precautions, calculations, and corrections which have to be entered into by the experimenters are given by Professor Fleeming Jenkin and others. One important correction is that which is due to the self-induction of the coil which retards the current, and a most important fact has been brought to light by Lord Rayleigh, namely, that this self-induction is considerably greater than it was thought to be by the original committee. Professor Rowland, assuming that an unknown error existed proportional to the square of the speed of rotation, has found that the original experiments of the committee lead to the result that the Ohm is 0·74 per cent. smaller than it was intended to be, and his own experiments lead to its being 0·89 per cent. smaller. Kohlrausch found it nearly 2 per cent. too great, and Weber thought it correct. The Cavendish laboratory experiments lead to its being 1·05 per cent. too small, and the elaborate paper to the Royal Society in which this result is given promises a re-determination with new apparatus on the same principle. In making the present determination a new method of suspension of the needle, a stroboscopic method of measurement of the speed—the old governor and the tinkling bell being discarded—and

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driving the coil by means of a water turbine instead of by hand, are some of the improvements which have been introduced.

It is to be remembered that no re-measurement of the Ohm can ever affect our use of it as a standard. It is no longer to be regarded as exactly equal to one thousand million C. G. S. units, but this is of no more consequence than the fact that one gramme is no longer regarded as being exactly equal to the mass of a cubic centimetre of water at 4° C.

THE FUTURE OF THE POSTAL TELEGRAPHS.

An eminent critic and man of letters, speaking at a public dinner the other day, remarked that the study of literature might be optional, but that for the future the study of science would be obligatory. Coming from such a quarter, the prediction was uttered perhaps more in sorrow than in hope. But whether true or not for education in general, it was certainly true of the training essential for certain professions, and for none more conspicuously than that of the telegraph engineer. This is a statement admitting of no question as regards the strictly professional engineer; but when we come to apply our remarks to the officers of the telegraph service controlled by the Government of this country, we are not so sure that their qualifications are universally regarded as professional, or, indeed, that any special qualifications, scientific or technical, are considered indispensable for the performance of their duties. Of its engineering staff as defined by Blue Books and classifications this, of course, is far from being true. But the staff so defined forms only a small portion of the controlling body who manage the affairs of the Post Office telegraphs, and the natural tendency is rather to diminish than to enlarge it. We say natural tendency, because it has been obvious from the moment when the telegraphs were acquired by the Post Office that the Post Office would, sooner or later, appropriate the management to itself. It has done so already in the departments of traffic, and in all branches alike its domination is unquestioned. If this process is less complete in what, for brevity's sake, we will call the technical branch, it is due partly to the survival of fit and competent men from the old services, partly to prudential and economical considerations, but partly also, we venture to surmise, from the slowness of the postal authorities to qualify themselves for the proper administration of that important branch.

If we are right in this conjecture there is much to be regretted, looked at from any point of view we may. Casting our eyes down the list of members belonging to the one and only Society representing the practical as well as the scientific aspect of telegraphy in this country, the names include most of those who were formerly prominently connected with the old telegraph companies, and many who have made their mark since those concerns were absorbed; but for the names of postal officers, officers who are or may become the real masters of the telegraph, and who one might have supposed would by this time be masters of telegraph science—these names we look for, but we certainly do not recognise them there. The tale of scientific publications points to the same inference, the fact being that periodicals devoted to telegraphy and electrical science get what little support they receive from the public service in this realm almost exclusively from the technical or operative branches of it. Among the last-named class, indeed, there is surprisingly little interest displayed. In this respect there is a marked contrast between them and similar grades in the United States, as well as in submarine cable companies all over the world. And this fact we count as part of the evidence upon which we are commenting, for if the superior officers took any interest in the literature of their profession their subordinates would be pretty sure to reflect some of it. Again, we have the testimony of the clerks who for some time past have been addressing themselves to the unfolding of grievances. We are not inclined to attach excessive credence to evidence of this kind, but there is one allegation so frequently made and so inherently incredible as a pure invention that we cannot entirely reject it; it is that there is a disposition all round amongst their postal superiors to undervalue the character and importance of the telegraphists' work. There is hardly any accusation that could be at once more painful and more damaging. And what is worse, it may unfortunately be true, for it is only human to depreciate what we do not or will not possess, ourselves. No such charge, we may be sure, would be brought against their superiors in the telegraph ranks proper; and if it were, it would be endurable; but that it has been made, and has not been denied as touching Post Office officials, is difficult to explain, except on the assumption that they have taken no pains to qualify themselves as judges. We do not pretend to be surprised, and so long as the public service is carried on efficiently we have no right to complain of the state of things here disclosed. But we think that excellent reasons could be given for an alteration in these several respects, and we propose to state a few of them.

It is well known that the original idea in the minds of those who were instrumental in bringing about the transfer of the telegraphs to the State, and of those who have been deputed by the Legislature to inquire into its working since the acquisition, was to weld the two services completely into one, not nominally but actually and effectively. The Parliamentary Committee was very explicit on this point; and if Parliamentary committees were as far reaching as they often are far seeing, every surveyor and postmaster in the kingdom would by this time have acquired the rudiments of electrical knowledge, whilst their clerks would have found it to their interests to become practical electricians. Something of this kind seems to have been contemplated even in Mr. Scudamore's time. On the occasion of his complimentary election to the presidency of the Society of Telegraph Engineers at the beginning of 1873, he spoke as follows:—"It is my hope and belief that, year by year, a continually-increasing number of leading officers in the Postal Telegraph Department will enter the ranks of your society; that year by year the attrition between their minds and the minds of other telegraph engineers who may be assembled in this room will give rise to fresh developments of their science; and that year by year their example and their precepts will quicken, in an increased number of their subordinates, a desire not only to do their work but to understand, and improve, and simplify the means by which it is done."* In another part of the same address he remarked that he looked also beyond these benefits—looked "to the great body of persons who are engaged in the practice of telegraphy throughout the country, and who, though they cannot attend your meetings, may read the accounts of your proceedings; may learn therefrom that their occupation has attained the dignity of a profession, that it has the constant attention of men of the highest scientific attainments, and that, great as the progress of telegraphy has been during the last few years, the ultimate limits of its progress have not as yet been discerned by those best qualified to discern them." Speaking more directly of the ten or fifteen thousand persons who were then daily engaged in the practice of telegraphy, he added, "The existence and growth of your society cannot fail, as years go on, to attach the great body of telegraph *employés* throughout the country to their calling, to make them proud of it, and, by making them proud of it, to make them desirous of improvement."

With wider knowledge of the facts, Mr. Scudamore might have said that the workers always had been proud of their calling. Unless they have utterly changed in character they are so still; but the significant fact is that apparently they are no longer encouraged to be so. It may, perhaps, be objected that, by "leading officers," Mr. Scudamore did not mean leading postal officers; but it is plain to be seen that, whoever the leading officers were to be, their example was to inspire the rank and file below them. Now, events have placed the rank and file directly under postal officers; and we venture to assert that, if this arrangement had been foreshadowed by the eminent administrator whose words we have quoted, one condition of its fulfilment would have been that the example set from above should really mean something. He himself good humouredly referred to his ignorance of that which he was then strongly recommending to others; but he frankly avowed that his reason for promoting the interests of the Society of Telegraph Engineers was "because its growth ought to be, and must be, advantageous to the service" of which he had charge.

Since 1873 great strides have been made in the science of telegraphy, and greater things are continually expected of the public department practically representing it in this country. The microphone was not dreamed of, the telephone was a mere vision, and the electric light was a shapeless nightmare. Duplex telegraphy had hardly been realised, and "Quadruplex" had yet to be coined. Yet all these wonders have been realised in the brief space of seven or eight years. They have to be understood, mastered, worked, adjusted, and kept in order. Nobody can say but that to-morrow fresh discoveries may not be revealed, fresh difficulties have to be overcome, fresh demands upon the patience and ingenuity of the servants who minister to the wants, or demands, of a watchful and exacting public. In those eight years the number of telegrams forwarded from within the limits of the United Kingdom has nearly doubled, and the increase goes

* President's inaugural address. *Journal of the Society of Telegraph Engineers*, Vol. IV. 1873.

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on at something like two millions annually. The staff of working *employés* has increased almost in the same ratio; and, all the circumstances above referred to taken into account, it seems to us a most momentous question, what is the extent of the technical training these *employés* are expected to undergo? We have seen what, according to Mr. Scudamore, it ought to have been; and we have indicated our misgiving that it is not what he thought it ought to be. To all appearance the technical branch of the service does not reach the manipulating *employés*; and what really does reach them is a branch the members of which have not hitherto displayed much enthusiasm either in mastering or in fostering the study of electrical science. At all events we have been unable to discover evidence of it in any of the quarters to which we adverted at the outset.

A few obvious considerations, it seems to us, should weigh with all postal officers—with the rising young men among them at all events—to induce them to take up the study of this science, upon which one very important section of their department is built. In the first place it may be reasonably conjectured that at no very remote date the Civil Service Commissioners will take this subject in hand. They have long had charge of a very stiff examination for the Government telegraphs in India; and that a similar, if less trying, ordeal will have to be passed by candidates for the higher grades of the Post Office, upon whom ultimately must devolve the sole responsibility of the telegraphs in England, is not only fitting but in the highest degree probable. Unless, therefore, the existing body of officers are content to submit to their effacement by a new set of men, possessing higher credentials, they ought to bestir themselves to render such effacement impossible. They have a good start, and plentiful opportunities for acquiring that practical knowledge which outside students can never command. If they lose in the race it will be entirely their own fault. We would point out also that the prizes are valuable. Electrical science is in the ascendant, and if any proof were needed of the money value attached to the possession of every description of electrical knowledge we might point to the antecedents and careers of the leading electricians of the the present day, outside the Government telegraph service as well as inside.

Our space will not admit of further development of this subject, and we must content ourselves in conclusion with pointing out the increased weight that would be lent to their authority if the officers of the Post Office were the superiors, or even equals, of their subordinates in point of technical knowledge. Self-interest and expediency point in the same direction, and speaking as we do on behalf of the future of a great public department, we strenuously urge this matter upon the attention of the authorities as the one and only means by which the administration can permanently maintain its present high reputation.

THE EFFICIENCY OF SECONDARY BATTERIES.

The performance of secondary batteries comprises two phases, the *charge* of the accumulator by the action of an external source, and its *discharge* in the working circuit. Now, each of these operations involves a certain loss of power, and this loss has been recently investigated by M. Emile Regnier, the well-known French electrician.

He considers, first, the case of an incandescent electric lamp, in which the resistance of the circuit is a constant quantity. The elements of the question are as follow:—

- E_0 the initial electromotive force of the source.
- R_0 resistance of the source.
- E electromotive force of the secondary battery.
- B resistance of the secondary battery.
- E_1 difference of potential between the two extremities of the conductor raised to incandescence.
- R_1 resistance of this conductor.
- t the time of the charge.
- t_1 the time of the discharge.

The work, T_0, expended in charging will be

$$T_0 = E_0 \frac{E_0 - E}{R_0 + R} \cdot t. \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The work, T, utilised in the incandescent conductor will be

$$T = \frac{E_1^2}{R + R_1} \cdot t_1. \quad . \quad . \quad . \quad . \quad . \quad (2)$$

To find the ratio of these two works, we must express t_1 as a function of t. This can be done by considering that the quantity of electricity, Q, is the same in the charging and discharging circuits, and that this quantity is proportional to the products of the intensities of the currents by the times; from whence is the equation

$$\frac{E_0 - E}{R_0 + R} \cdot t = Q = \frac{E_1}{R + R_1} t_1;$$

and hence

$$t_1 = \frac{t \frac{E_0 - E}{R_0 + R}}{\frac{E_1}{R + R_1}}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

By substituting for t_1 its value in the expression (2), this becomes

$$T = \frac{\frac{E_1^2}{R + R_1} \cdot \frac{E_0 - E}{R_0 + R} \cdot t}{\frac{E_1}{R + R_1}} = E_1 \frac{E_0 - E}{R_0 + R} \cdot t; \quad . \quad (4)$$

whence we get the yield of the battery

$$\phi = \frac{T}{T_0} = \frac{E'}{E_0}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

The efficiency is expressed, therefore, by the ratio between the difference of potential between the two ends of the resistance, which is incandescent, and the initial electromotive force of the electric source. It is independent of the resistances and the values of the times of charge and discharge.

In the foregoing investigation M. Regnier has supposed that the work was done by the discharge in the heating of a wire or conductor; but if the discharge current acts in a circuit which is itself the seat of an electromotive force—say, an electric motor—the expression for the efficiency is not altered. It is then incumbent, however, not to take for the value of E_1 the difference of potential at the two ends of the motor, because E_1 ought to express the inverse electromotive force of the motor at the origin of the induction. We ought to arrive at the expression indirectly by putting

$$T_0 = Q E_0 \text{ and } T = Q E_1,$$

from which we get

$$\phi = \frac{T}{T_0} = \frac{E_1}{E_0}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

These formulæ show how the resistances vanish from the final expression; they give us the relative and respective values of the times of charge and discharge; and show us that if the resistances do not act upon the final yield, they influence the time, and consequently the values, of the work expended and recuperated in unit time.

In practice, the resistances of the circuits ought to be taken into consideration. It is because of its very feeble internal resistance that the secondary battery of M. Faure gives a return of power or efficiency of 80 per cent. under advantageous conditions. In fact, the constants of the Faure battery are, for the small model of 7·5 kilograms,

$$E = 2{\cdot}15 \text{ volts},$$
$$R = 0{\cdot}006 \text{ ohms}.$$

Making

$$E_0 = E_1 1{\cdot}1 = 2{\cdot}\ 36 \text{ volts},$$
$$E_1 = E_1 0{\cdot}9 = 1{\cdot}\ 93 \text{ volts},$$
$$R_0 = R \quad\ = 0{\cdot}006 \text{ ohm},$$
$$R_1 = R \ \cdot 9 = 0{\cdot}054 \text{ ohm}.$$

The work expended during the charge will be

$$\frac{E_0^2 - E E_0}{g (R_0 + R)} = 4{\cdot}21 \text{ kilograms}$$

per second and per pair, a rule which admits of saturating the battery in a time of charging much shorter than usual.

The work recuperated per second and per pair during the discharge will be equal to

$$\frac{E_1^2}{g (R + R_1)} = 6{\cdot}3 \text{ kilograms}.$$

As to the efficiency, it is, under these conditions, equal to

$$\frac{E_1}{E_0} = \frac{0{\cdot}9}{1{\cdot}1}, \text{ or } 81 \text{ per cent.}$$

ELECTRIC RAILWAYS AND TRANSMISSION OF POWER BY ELECTRICITY.*

BY ALEXANDER SIEMENS.

When electricity was first utilised for practical purposes, the cost of producing it precluded its application to anything but giving signals or working small and delicate apparatus, requiring

* Paper read at the Society of Arts on May 18th.

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only weak currents to perform their functions; but by the discovery of the dynamo-electric principle, some fourteen years ago, powerful electric currents have been placed at our disposal, at a cost which enables us to transform into commercial processes a number of experiments which, up to that time, served only as illustrations of scientific lectures.

The machines which have caused this revolution in the application of electricity consist essentially of two parts—the fixed electro-magnets, by which a powerful magnetic field is created, and the revolving armature, which is connected with the commutator. When the machine is in action, the rapid motion of the copper wire through the magnetic field induces an electric current, which leaves the helix by the brushes pressing against the commutator on opposite sides. From the brushes the current passes to the electro-magnets, and afterwards to the outer circuit, where it has to perform the useful work. In traversing the coils of the electro-magnets, it increases the intensity of the magnetic field, which in its turn induces a more powerful current, and this mutual strengthening of current and magnetic field goes on until a balance establishes itself in the manner afterwards described.

The researches of Sir William Thomson, Dr. Hopkinson, Professor Ayrton, and others have proved that such machines, if properly constructed, will render in the form of electrical work up to 90 per cent. of the energy expended upon them in the form of motive power. It may, therefore, be conceded that they are very efficient transformers, and that we can hardly hope to exceed the results already obtained by the best types of dynamo-electric machines. If, instead of using such a machine to generate electricity you send a current into it, the magnetic attraction created between the poles of the electro-magnets and the currents traversing the armature will cause the latter to rotate, and this motion can be communicated to other machinery in the usual ways. A pair of such machines, one for producing electricity and the second for retransforming the current into motive power, can, therefore, be utilised for transmitting power to a distance. In order fully to understand the manner in which this transmission is effected, a large number of experiments were made at the works of Messrs. Siemens and Halske, in Berlin, by Dr. Frölich, and the results obtained were laid before the Royal Academy of Science in Berlin by Dr. Werner Siemens on the 18th November, 1880.

The principal conclusions arrived at were the following:—On applying Ohm's law to a magneto-electric machine (a machine with permanent magnets) we find that the strength of current for a given total resistance is:—

$$C = \frac{n \times M \times v}{R}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

In this formula C signifies the strength of current; n, the number of convolutions of wire on the armature; v, the number of revolutions per minute; R, the total resistance in circuit; M, the total E.M.F. produced by the permanant magnets and the iron of the armature in one convolution of wire, when $v = 1$; this quantity will afterwards be called "effective magnetism" of the machine.

The same formula holds good for a dynamo-electric machine. In this case, however, the "effective magnetism" (M) depends on the strength of current (C), and the formula, by substituting $f(C)$ for n (M), becomes—

$$C = \frac{v f(C)}{R}, \text{ or } \frac{C}{f(C)} = \frac{v}{R}. \quad . \quad . \quad . \quad . \quad (2)$$

In the latter form the very important law is expressed that the strength of the current in a given dynamo-electric machine depends only on the ratio of the number of revolutions per minute to the total resistance in circuit. If we determine, therefore, f (C) for a machine, we can calculate beforehand the strength of current it will produce with a given number of revolutions in a given resistance.

The first series of experiments was made to test the correctness of this conclusion, and the curves I., II., and III., embody the results obtained by working one of the largest "Siemens" dynamo machine (type D_0) through various resistances at different speeds. The total resistance of the machine was, in case (I.), ·435 S.U.; in case (II.), ·725 S.U.; and, in case (III.), 7·14 S.U.

By way of comparison, the curve IV. was set out from results published by Messrs. Meyer and Auerbach in "Wiedemann's Annalen," Band 8, p. 494, who had experimented with a "Gramme" dynamo machine. As will be seen, all these curves do not differ materially from a straight line, and, for the limits of practical working, they fully confirm the above theory. There exists, therefore, a curious similarity between magneto-electric and dynamo-electric machines. In both, the strength of current is proportionate to the ratio of revolutions per minute to total resistance, although the magnetism of the magneto machines is a constant quantity, and that of the dynamo machine varies with the strength of current. The important difference between the two kinds of machine is, that magneto machines give a current however slow their motion is, whereas dynamo machines only begin to give a current when the ratio of number of revolutions to total resistance attains a certain magnitude.

The nature of the f (C) was then further examined, and the influence on the magnitude of the "effective magnetism" of the currents set up in the iron of the armature by its quick rotation in a magnetic field, and by the currents traversing the coils of the armature. The results arrived at are represented by the curves V., VI., VII., for the large Siemens machine, and by the curve VIII. for the Gramme machine referred to above. They show that at first the "effective magnetism" increases in proportion to the increase of current, then it deviates more and more until it very gradually reaches a maximum, and for still more powerful currents it decreases again. The latter peculiarity is to be accounted for by the fact that the iron bars of the electro-magnet cannot be magnetised beyond a certain point, whereas the diminishing influence of the currents on the magnetism in the iron of the armature increases continually with the strength of these currents. In practical applications such powerful currents are seldom met with, and it will suffice for the present purpose to assume that the "effective magnetism" gradually approaches a maximum.

When two machines, identical in their construction, are connected to transmit power, the "effective magnetism" in both should be equal, as the same current circulates through both of them. The following equations will, therefore, exist between the various quantities:—

$$E_1 = n M v_1,$$
$$E_2 = n M v_2,$$
$$C = \frac{E_1 - E_2}{R} = n M \times \frac{v_1 - v_2}{R},$$
$$W_1 = a \times E_1 \times C = a C^2 R \frac{v_1}{v_1 - v_2},$$
$$W_2 = a \times E_2 \times C = a C^2 R \frac{v_2}{v_1 - v_2},$$
$$H = a \times C^2 \times R,$$
$$W_1 = H + W_2,$$
$$N = \frac{W_2}{W_1} = \frac{v_2}{v_1} = \frac{E_2}{E_1}.$$

In these formulæ the index 1 refers to the machine producing the current, and the index 2 to the machine giving out the power; E stands for electromotive force; n, M, v, R, C, signify the same quantities as before; a is a constant depending upon the construction of the machines; H is the heat, generated in the system; W_1 is the work expended upon the primary machine; W_2 is the work given out by the secondary machine; N is the useful effect.

In comparing these formulæ with observations, it is easily seen that they cannot be quite correct. This is most conspicuous with the formula for the useful effect, $N = \frac{v_2}{v_1}$, according to which this should be greatest the more the velocity of the second machine approaches the velocity of the first machine, whereas actual experiments show that N is a maximum for a certain velocity of the second machine, and will decrease for any greater or lesser number of revolutions of the secondary machine. The cause of this discrepancy is the influence of the so-called Foucault's currents, which are set up in the iron of the revolving armatures by the proximity of the powerful electro-magnets.

In the primary machine these currents circulate in the same direction as the currents in the covering wire of the armature, weaken the "effective magnetism," increasing the work W_1 expended upon the primary machine. In the secondary machine, however, in which the armature turns in the opposite direction, these Foucault currents circulate in the opposite direction to the currents of the armature wires, and by thus strengthening the effective magnetism and the electromotive force E_2, they diminish the work W_2, given out by the secondary machine.

As our machines are supposed to be of identical construction, the following formula will express the relative proportion of the different quantities relating to the Foucault currents:—

$$M_1 = M - e c_1,$$
$$M_2 = M + e c_2,$$
$$c_1 = \frac{M_1 v_1}{u} = \frac{1}{n} \cdot \frac{E_1}{u},$$
$$c_2 = \frac{M_2 v_2}{u} = \frac{1}{n} \cdot \frac{E_2}{u}$$

M signifies the effective magnetism, such as it would be if no

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Foucault currents existed; M_1 and M_2, the actual effective magnetism of the two machines; c_1 and c_2, the strength of the Foucault currents; u, the resistance through which these currents circulate; v and n having the same meaning as before; and e, being a constant, depending on the construction of the machines.

If we calculate from the above equations the value of M_1 and M_2, substituting at the same time $y = \frac{e}{u}$; we have:—

$$M_1 = M(1 - y v_1),$$
$$M_2 = M(1 + y v_2),$$

and for the electromotive force of the two machines

$$E_1 = n M_1 v_1 = n M (1 - y v_1) v_1,$$
$$E_2 = n M_2 r_2 = n M (1 + y v_2) v_2.$$

This gives us for the current

$$C = \frac{E_1 - E_2}{R} = \frac{n M}{R} [v_1 - v_2 - y(v_1^2 + v_2^2)],$$

and for the work expended and given out respectively

$$W_1 = a n C M_1 v_1 + a c_1 M_1 v_1,$$
$$W_2 = a n C M_2 r_2 - a c_2 M_2 r_2;$$

or, if we substitute $p = \frac{a}{n_2 u}$,

$$W_1 = a C E_1 + p E_1^2,$$
$$W_2 = a C E_2 - p E_2,$$
$$N = \frac{W_2}{W_1} = \frac{E_2}{E_1}\left[1 - \frac{p}{a C}(E_1 + E_2)\right],$$
$$H = a C (E_1 - E_2),$$
$$F_1 = p E_1^2,$$
$$F_2 = p E_2^2,$$
$$W_1 = W_2 + H + F_1 + F_2.$$

In these formulæ the symbols have the same signification as before, and F_1 and F_2 signify the work done by the Foucault currents.

The electrical quantities E_1, E_2, and C admit of an easy measurement, and by the help of the above formulæ, the quantities W_1 and W_2 can be determined beforehand, when the constants of the machines are known.

A great number of experiments were then made, in which all the quantities were measured, and the observed results were compared with the quantities calculated from the above formulæ, and it was found that they agreed very well. It is hardly necessary to observe that these formulæ are applicable to all types of dynamo-electric machines, whatever their construction may be, the character of each type determining the constants.

The idea of utilising these machines for transmission of power presented itself to Dr. Werner Siemens as long ago as 1867, when he discussed at the Paris Exhibition with other members of the jury the possibility of elevated electric railroads; but the dynamo machine was at that time not sufficiently developed to admit of a practical execution of the idea, and when the present more perfect forms were invented electric lighting monopolised for a time all the attention that was bestowed upon the practical application of the machines.

During the efforts which have been made to introduce electric lighting on a large scale the idea of applying the light-giving machines during daytime to distribute power has come to the front again, and as such an application means a further utilisation of the invested capital the combination of lighting with transmission of power is sure to be made.

For this purpose a central station has to be established in a district in which powerful steam engines, working on the most economical principles, drive a number of dynamo machines, which produce the electric currents. Secondary batteries, similar to those constructed by M. Planté, and improved by M. Faure, may be employed to receive the electricity, and keep it ready for use in the same manner as the gas is stored in large gas-holders, and as accumulators are used in connection with hydraulic machinery.

From the station cast-iron pipes are laid through the streets similar to those now in use for distributing gas or water, and insulated wires are drawn into them for conveying the currents from the machines to their destination. At convenient intervals the wires are made accessible by so-called "road boxes" inserted in the pipes, from which the connection to houses or lamp-posts can be made. Two separate sets of wires would be required for the lighting and for the transmission of power, the commutators for directing the currents being placed in the station, and additional commutators could be fixed in the houses for switching the current from secondary machines to lamps without communicating with the station.

There is no doubt that much has to be learnt before all the details of such a central station and of a practical system of distribution have been brought to perfection; but there are nowadays few obstacles that cannot be surmounted, and even our present knowledge is advanced enough to teach us that there is nothing impossible in the idea sketched out above.

When a certain amount of power has to be transmitted by electricity to the given distance it is easy to determine experimentally what power is required to drive the primary machine, as the exact conditions under which the trial was conducted can be readily reproduced in the practical application. In this respect the transmission of power by electricity possesses a great advantage over the transmission of power by water or air, as the friction and leakage of the pipes through which the latter have to be conducted can never be determined in advance. It further has the advantages that the secondary machine works without producing any waste which has to be disposed of, and that the small size and low weight of the machines obviate the necessity of heavy foundations for them.

In considering the possibility of employing the electric current to distribute power from a central station, the proportion of the power given out by the secondary machine to the power expended upon the primary machine will not be of that deciding influence as is generally supposed. Granted even that not more than 45 per cent. of the power expended can be reclaimed, it will still be possible to produce the power required at a cheaper rate than if each small place had its own steam-engine. For, at the central station, 1 h.-p. could be produced by the large steam-engines with about 2½lb. of coal, so that 1 h.-p. given out by the secondary dynamo machine would be produced by burning 5lb. of coal per hour. There are few small steam-engines which will produce a horse-power with that expenditure of fuel, and if we take into account the trouble and risk connected with the running of steam-engines, it may be readily admitted that this loss is no real obstacle to the introduction of the electrical transmission of power. Of still less consequence will this loss be where waterfalls or other natural forces can be employed to drive the primary machines, in which case the power would cost practically nothing, beyond the interest on the capital and the depreciation of the machines. The applications which it has hitherto found have, to a certain extent, been of a tentative nature only, and on a small scale, but they are nevertheless very instructive, as they show that economical results can be obtained by it.

(TO BE CONTINUED.)

LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY (LIMITED).

The third ordinary general meeting of the shareholders of this Company was held on the 23rd inst., at the offices, Old Broad-street, Mr. PENDER, M.P., presiding.

The SECRETARY (Mr. William Payton) read the notice convening the meeting, and the minutes of the last meeting, which were confirmed and signed by the chairman. The report of the directors, which appeared in *The Electrician* of last week, was then taken as read.

The CHAIRMAN said that he would first refer to the realisation of the Uruguayan Government debt. They were aware that the South American Governments, were sometimes not in a very great hurry to pay, but the directors believed that, from the representations of their agent, from the exertions he had been making from time to time to secure the payment of the present monthly account of the Government, from the pressure he had brought to bear, and from the influence which he appeared to possess, they were justified in looking with some little hope upon that account as a good item. In order, however, that there might be no question at all about it they had placed aside a sum equal to that amount, which would be retained in the position of reserve fund till they saw whether the amount was actually paid or not. With the advice of their accountant, Mr. Griffith, in whose hands their accounts were very carefully dealt with, they had restored the sum of £1,384, which, in last year's accounts, was deducted from the debt to meet loss on exchange to the revenue account. As regarded the traffic receipts for last year, although they were not large, still there was an increase; and they trusted that with a cycle of good times, having now, as they hoped, passed through a cycle of bad times, and with better trade, they might see a very considerable improvement in the traffic; but that must result not so much from the exertions of the Platino Company as from the exertions of the Western and Brazilian Company. They had engaged the cables of this Company, who participated according to the amount earned. They received one-fifth of all the earnings of the Western Company, who kept the Platino Company's system in perfect working order. The land lines, which were more particularly under their own control, had improved—they were £1,000 a year better this year than last; and, therefore, they had reason to be satisfied, looking at the state of the country, with the improvement which had taken place in their land line system. They believed that the management was fairly efficient, and since the land lines came into their control they had endeavoured to put them in such a state as to do the work in a manner in which it ought to be done. The cable receipts in 1879 were £17,859, while in 1880 they were £18,590, or an increase of £631. That increase he was disappointed with. He did not think it was equal to the increase

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upon the general telegraphic system, of which they had considerable cognisance; but, as he had said, they could not interfere beyond making certain representations to the Western and Brazilian Company, and the question of increase rested in that quarter. He might mention that certain competition had sprung up in the Brazilian system of land lines which was affecting the cable system. He believed that this had materially interfered with the cable system. At the Board that day they had passed a resolution drawing the attention of the Western and Brazilian Company to the matter, and suggesting to them to try and make some arrangement with the existing land lines of Brazil, as he believed if an arrangement were not made things might get worse instead of better. There was no doubt at all, from the letters they had received from Brazil from their agent, that the principle they were going on was to lower considerably the tariff of the land lines. If proper arrangements were made the result might be that the Brazilian and Argentine Governments might possibly come to an arrangement whereby they might absorb the whole of the land lines, leaving the cable system to be managed by the English companies. However, that was a question to be further considered. If he understood Mr. Hollocombe, who had a thorough knowledge of the country, there were gentlemen who seemed to have a contrary opinion, but it appeared to him that that was the only possible way of dealing with the land lines—that there might be some arrangement whereby the Government would possess them, or some principle might be arrived at whereby the service generally would be promoted and the interests of the shareholders more respected. This Company had in their small system of land lines fourteen stations, and the expenses averaged about £300 per annum per station, with about £2,000 for Montevideo, the principal station. There were many new shareholders as compared with twelve or fifteen months ago, and he thought it might be well to let them know something of the origin of the Company, or rather of how the parties who were now working it became interested in it. The Company was formed originally in the Brazils. Mr. Albert Grant became the agent of the Company, and he was also by far the largest shareholder. Other parties, however, became possessed of shares; and a number of shareholders were constantly writing to him (the chairman) and other gentlemen. They said, "We can get no account whatever of our company's affairs. We get no dividend, and there are no meetings, and therefore the thing is virtually drifting to ruin." One of the directors represented very considerable interests, as did he (the chairman) and they were induced to take the question up. He might say that he took it up with the greatest reluctance. It was with no desire to take on himself additional labour that he went into this Company, but on the broad principle that submarine telegraphy had now become a very great international question; and representing as he did some of the very largest interests in submarine telegraphy, he thought it was a duty he owed to the shareholders referred to to help them—to give them the benefit of his experience and the experience of those associated with him in bringing this Company out of inevitable ruin, and in hoping to place it in a fair and satisfactory position before the public and the other shareholders. It was not for him to tell them the difficulties they had in bringing the Company into the position which it occupied at the present moment. When he told them that it was a Brazilian Company, and that they had to convert it into an English Company, he thought that Colonel Tilney, who had some knowledge of these affairs, would admit that it was no easy or simple matter to do. They had to go to considerable expense to secure the very best talent they possibly could to send out to Brazil, and he believed that it was entirely owing to their colleague, Mr. Hollocombe, who went out to the Brazils, who brought the thing about, and brought home with him such powers as enabled them to convert the Company into what he might now call a paying company. When they took up this concern the relative shares might have been bought at 40s. or 50s.—in fact they were considered all but worthless, but that day they were worth £6 he believed; and he thought that the directors were entitled to some consideration and to some confidence from even the new body of shareholders, for having rescued the concern from ruin, and placed it in such a position that one of the leading sharebrokers in Liverpool could recommend it to his friends as a safe and permanent investment. He thought they were right to claim some credit for what they had done in that respect. They had converted a property which was worthless into one which was, he supposed, paying to-day between 4 and 5 per cent.; they had also given the shareholders a security which they did not possess before; they had made it an English company, under English laws; they had paid regular dividends, and if the general telegraphic property and the general trade of the country improved, he hoped they might by and bye pay a larger dividend. The board had a policy which they hoped eventually to carry out, but before they dealt with that policy they would consult the body of the shareholders. They would take no step which would commit their property in any shape or form to any policy they might have with the Western and Brazilian Company or other company—they would take no step to commit the shareholders without their full concurrence and consent. In addition to what he had stated they had done more. They had to invest £1,241. Seeing that the progress of this Company in the way of dividend had not been as great as they desired it to be, the directors, notwithstanding all the trouble and labour they had had, and although in the articles of association the *honorarium* was put at £1,200 a year, the directors had consented to take from this £1,200 a year £200 and to place it along with the £1,241 balance of reserve fund uninvested to the reserve fund. They were doing this not so much for the purpose of showing that what they had received was too much, for he thought it was not too much remuneration for the services they had performed, but they wished to show the shareholders that they had some sympathy with the original shareholders—more, perhaps, than they had with the shareholders who had lately joined, because the original shareholders were getting very little on the par value of the shares, and the new shareholders were getting a very fair amount of consideration. If they had stood by the remuneration which the articles of association entitled them to take he did not think it would have been at all unreasonable, having found for the new body of shareholders an investment giving them now probably 4 per cent., and which would eventually give them something more. He, therefore, thought if they were entitled to consideration at all—he knew that they had the fullest consideration from the original shareholders, whose property they had saved—that they were entitled to the fullest consideration from the new shareholders for finding them an investment which was likely to prove remunerative. He thought that Colonel Tilney showed his judgment and his knowledge of business when he advised a number, and a very large number, of his friends to take an interest in this concern, knowing, as he possibly did, that it would give eventually a fair return on the money he advised them to invest. They knew the difficulties against which their predecessors had to contend, and also the difficulties which they themselves had had, and they knew that it was from a practical knowledge of what they were doing which had enabled them to place this concern in a proper position. He thought, with these remarks, that he had probably satisfied them with what had taken place since the Company came into their hands. He concluded by moving, "That the report and accounts for the year ending the 31st of March, 1881, be, and they are hereby adopted, and that a dividend be declared of 3s. per share, free of income-tax, payable this day."

Captain FRANCIS PAVY briefly expressed his pleasure at seconding the motion, which was carried unanimously.

Colonel TILNEY observed that he had been very pleased to hear the remarks of the chairman. He was very glad, as he had recommended his friends to purchase shares in the enterprise as a sound and good investment, to have his view confirmed by the chairman, who clearly expressed his feeling that there was likely to be still further improvement. He thought it right to mention to the meeting that he had lodged 90 proxies, and that he represented seventy-seven friends, who held 10,179 shares, having purchased them as a permanent investment. He induced his friends to buy shares in the undertaking after much thought and consideration, and having faith in the future of the Company. Good as the concern was, however, he thought that it might be much better. He then proceeded to criticise the articles of association, and said he was very glad to hear the chairman state that nothing would be done in the shape of fusion or amalgamation without the concurrence of the shareholders, because under the articles of association the directors could apparently do what they liked. He thought the directors' fees were very large, and was glad that they had given up £200 of the £1,200 to the reserve fund. He asked when it was likely that their claim of £7,000 against the Uruguayan Government would be settled.

The CHAIRMAN replied that it was really impossible to say. He might state that it was an old debt which the present board had taken over.

Mr. HOLLOCOMBE stated that it arose during the revolutionary times.

Colonel TILNEY: Is it an acknowledged debt?

Mr. HOLLOCOMBE replied in the affirmative.

Colonel TILNEY thought that that was so far well. He considered, much as the shareholders were indebted to the board in the past, that the expenses at present were very serious, and he inquired whether they could not be reduced.

The CHAIRMAN thought that when everything was settled in connection with the conversion of the undertaking into an English company that there would be a diminution of the present expenses.

Colonel TILNEY, after further observations, read the following resolution:—"That it be respectfully recommended to the board, pending the necessary amendments of the articles of association, that they shall accept one-half of the sum named (£1,200) in the articles as their remuneration, and that they be invited to increase the number of the board to at least five, the maximum number being seven, and the present board being at its minimum number of three."

The CHAIRMAN having replied,

Colonel TILNEY said that he had been disarmed by what the chairman had stated, and he withdrew the resolution, subsequently taking a similar course, on the same ground, with the following resolution:—"That the board be recommended to revise and amend the articles of association, and to submit them for the approval and adoption of an extraordinary general meeting." He further submitted the following resolution:—"That it is hoped the board will in future refrain from sending out proxies at the expense of the shareholders with the directors' names printed thereon, it tending to prevent the shareholders having free control over their own property, and the legality thereof being doubtful."

Mr. NORTON, solicitor, who also made a few remarks defending the articles of association, replied on the legal point concerning the proxies.

Mr. HOLLOCOMBE stated that unless proxies were issued the shareholders in the River Plate and the Brazils, whose interests he had undertaken to watch over, would be ignored.

The CHAIRMAN also stated that he could not consent to the resolution, as it implied what had really not happened, for the directors themselves had paid the expense of the proxies.

Col. TILNEY ultimately withdrew the resolution.

On the motion of the CHAIRMAN, seconded by Colonel TILNEY, Mr. Hollocombe was re-elected to his seat at the board; and Messrs. Deloitte, Dever, Griffiths, and Co., the retiring auditors, were subsequently re-elected.

Colonel TILNEY then moved, and Mr. R. KENDAL seconded, a vote of thanks to the chairman and directors, and it was carried unanimously.

The CHAIRMAN acknowledged the compliment, and the proceedings then terminated.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY (LIMITED).

The fifteenth half-yearly general meeting of this Company was held on the 20th inst., at the Cannon-street Hotel, under the presidency of the Right Hon. Viscount Monck.

The SECRETARY (Mr. Richard Collett) read the notice convening the meeting and the minutes of last meeting, which were approved, and signed by the chairman as correct. The directors' report, which appeared in *The Electrician* of last week, was taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, congratulated the shareholders on the condition of the Company. Their property was in admirable condition, and the report of the electricians showed that their cables continued as effective for all purposes as they ever were. That in itself was a matter of great congratulation, because that being their fifteenth half-yearly meeting they were getting to a respectable age. With regard, too, to what their cables had been doing for them, they also had what our cousins on the other side of the Atlantic called a very "good exhibit."

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The receipts for the half year ending on the 31st of December, 1880, were £82,000 odd, showing an increase of £4,000 over the previous six months, and an increase of £4,580 over the corresponding half year of 1879. At the last two or three meetings, in speaking of the traffic receipts, he had drawn their attention to the fact that, previous to the completion of the telegraph system to the Cape of Good Hope, and during the Zulu War, they received a considerable accession of income by telegrams sent home from the Cape through Madeira. In the December half year of 1879 they received from that source £3,700, which, of course, could not be reckoned as normal traffic; and as the traffic for the December half year of 1880 exceeded that of the December half year of 1879, including this £3,700, by £4,580, it followed that their normal traffic had increased by £8.280. This, he thought, was very satisfactory, and, in fact, if they looked at the table in the report giving the monthly receipts from the institution of the cables to the close of the last half year, they would see that there had been, not a very large, but a gradual and continuous increase in the traffic. He also had the pleasure to inform them that the receipts since the 1st of January last showed a similar increase. They had taken about £3,000 more in the portion of this year which had already elapsed than they took in the corresponding months of the previous year. The next question was, how they disposed of the money. First, they must pay their expenses, which showed a small increase in the half year of £36. He had often said that the directors had no wish whatever to keep from the shareholders any of the earnings which they could give them with due regard to the permanent interests of the enterprise. They, therefore, this year paid them 6 per cent. as ordinary dividend against 5 per cent. dividend and 1 per cent. bonus last year. They had had a considerable increase of traffic; they were able to put by what they thought necessary and judicious for the reserve fund; and they left the shareholders, from what the directors did last year, to draw their own conclusions as to what their conduct would be at the end of the current half year, when they made up the accounts. These were the only observations he felt called upon to make.

Sir JAMES ANDERSON having seconded the motion,

Mr. URWICK congratulated the directors on the decision which they had arrived at to increase the dividend, and if he understood aright they might look forward to an increase next September, which would be very gratifying to the shareholders. He then proceeded to argue that the time had arrived when a certain stated sum—£30,000 or £40,000 a year—should be put to the reserve fund, and that the shareholders should receive all that remained. They had now over £300.000 of reserve fund, including the spare cable, and their investments—on the nature of which he congratulated them—showed a considerable increase over the sum paid for them. Their cables were in three sections, on good foundations, and he thought it was only by accident that they need look for anything happening. He objected to the principle of the company insuring the lives of their *employés*, and thought if they were underpaid that their salaries should be increased.

Mr. HILL suggested last year, and he suggested now, that a certain definite sum should be put to the reserve fund, in which case the shareholders would thoroughly understand the position of the company.

Mr. H. P. STEPHENSON thought that the chairman's statement was very satisfactory, with this exception, that he indicated in a very vague manner the amount which might be carried to the reserve fund, and the amount of the extra dividend which they might receive at a future time. He quite approved of a large reserve fund; but he thought with the actual amount at the credit of the fund, the spare cable, and the profit on the investments, they might assume that they had something like £350,000 to reserve. He thought it would be only fair to the shareholders that they should know what amount was to be carried to the reserve, and what the increase of dividend would be.

The CHAIRMAN thought the board might congratulate themselves on the tone of the discussion. He had frequently expressed his views as to the reserve fund. He would remind Mr. Urwick that the cables were laid at the same time, and that the same cause which would operate to suspend the action of one would operate to suspend the action of the others; and therefore he confessed that he should never feel perfectly satisfied until they were in a position, without calling on the shareholders for additional capital, to relay their whole system. One gentleman had said that the argument in favour of those *employés* who had been a long time in the service of the Company receiving larger salaries applied to the shareholders, who should, therefore, receive larger dividends. The board entirely recognised the validity of this view, and he thought their conduct showed it. Another gentleman stated that he (the chairman) had spoken vaguely as to the future prosperity of the dividend, but he really thought that the shareholders understood what he meant. He would reserve his remarks as to the question of insurance.

Mr. URWICK remarked that in his observations as to the cables he had not spoken from the point of view of their wearing out.

The CHAIRMAN replied that he had spoken on the subject from that view. He had had some experience, and he should be sorry to say what the "life" of a cable would be.

Mr. JOHN NEWTON thought that the cable having now been laid eight years, and on a good bottom, was in favour of its "life" being very long. He was glad that a dividend of 6 per cent. had been declared instead of 5 per cent. and a bonus. He thought that £50.000 a year was quite enough for the present generation of shareholders to put to the reserve fund for the benefit of future generations.

The CHAIRMAN put the resolution, and it was carried unanimously. Continuing, he moved the following resolution:—"That the Board of Directors be and hereby are authorised to make and carry into effect, and, if they think fit, from time to time alter and vary the arrangements for assisting the *employés* of the Company in effecting insurances on their lives; and for this purpose to pay out of the revenues of the Company such sums as they may from time to time deem expedient, not exceeding in any case one half of the premiums required." He agreed that, according to the strict rules of political economy, the *employés* ought to be left to insure their own lives; but, if they looked around them, they saw that all the great employers of labour in the country had found it necessary to do what was now proposed, or something analogous. The Government, for instance, did not insure the lives of their *employés*, but they granted retiring pensions. All the great telegraph companies did what this Company now proposed, and he believed that the Bank of England insisted on insurance on the part of its *employés*. Either what they now proposed ought to be done or they must increase the salaries, so it came to the same thing, though by what they proposed he believed they had a better bargain.

Mr. WILLIAM HENRY CLARK seconded the resolution.

Mr. GRIFFITH warmly supported the proposal, as did

Mr. WARREN, who referred to an interesting article on the subject in the *Nineteenth Century*.

Mr. HILL proposed, as a rider to the resolution, that the amount contributed for the purpose by the Company should be limited to £800 a year, in accordance with the estimate mentioned in the report.

The CHAIRMAN stated that that was the sum which the directors had ascertained might be necessary, but they would spend no more than was required.

Mr. NEWTON thought that the amount should be limited to £1,000 a year.

The CHAIRMAN stated that the shareholders would always see from the accounts what was the sum spent; and he really thought that the matter had better be left with the directors. The resolution was passed with three dissentients.

A vote of thanks to the chairman and directors was then proposed and carried unanimously, their conduct of the business of the Company being warmly commended.

The CHAIRMAN acknowledged the compliment, and assured them that they would always try and do their duty effectively.

The proceedings then terminated.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices May 25.		Business Done Week Ending May 25. Highest.	Lowest.
Anglo-American	56,	56¼	56¼	55⅞
Do. Preferred	87,	88	87⅞	86⅞
Do. Deferred	28,	28¼	28¼	27⅞
Brazil Submarine	10⅛,	⅜	10⅜	10⅛
Cuba	9⅛,	⅜	9⅜	9⅛
Do. Preference	16¼,	17	—	—
Direct Spanish	3¾,	4¼	4 1-16	4 1-16
Do. Preference	13,	14	13¾	13¾
Direct United States Cable	10⅞,	11⅛	11	10⅞
Eastern Telegraph	10,	¼	10¼	10
Do. 6 per Cent. Preference	12¼,	13	12¼	12¼
Do. 5 per Cent. Debentures, 1899	106,	109	—	—
Eastern Extension	11⅛,	⅜	11¼	11¼
German Union	11¾,	12¼	—	—
Globe Telegraph and Trust Company.	6¼,	⅜	6¼	6⅛
Do. Preference	12¼,	⅜	12⅜	12¼
Great Northern	12⅞,	13⅛	—	—
Indo-European	28,	29	—	—
Mediterranean Extension	2⅛,	¼	2⅛	2⅛
Do. Preference	9¾,	10¼	10	—
Reuter's	11,	12	—	—
Submarine	270,	290	—	—
West India and Panama	2,	¼	2¼	2 1-16
Do. 1st Preference	7,	¼	7¼	2 1-16
Western Brazilian	8,	¼	7¼	7¼
West. Union 7 per Cent. 1st Mortgage	120,	125	8¼	8¼
Do. 6 per Cent. Sterling Bonds	105,	109	—	—

TRAFFIC RECEIPTS FOR APRIL, 1881.

Companies.	April, 1881.	April, 1880.	Incrse.	Decrse
Cuba Submarine Company	3,100 estd.	3,139	—	39
Direct Spanish Telegraph Company	1,337	1,453	—	116
Direct United States Telegraph Company	14,660* estd.	13,940†	720	—
Eastern Telegraph Company	45,289	44,748	541	—
Eastern Extension Telegraph Company	26,746	24,342	2,404	—
Great Northern Telegraph Company	17 720	—	—	—

* At 2s. per word. † At 3s. per word.

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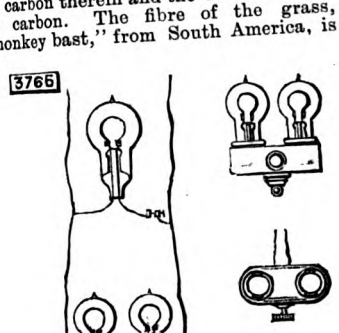
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

3765. IMPROVEMENTS IN ELECTRIC LAMPS AND IN CARBONS, OR INCANDESCING CONDUCTORS THEREFOR, &c., *G. E. G. Brewer.*—*Dated September 16th*, 1880.—(*A communication from T. A. Edison.*) 1*s.* 2*d.*

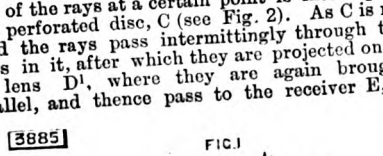
This invention relates to the well-known Edison lamp, and the inventor makes forty-four claims relating to the various parts of the lamp, the carbon therein and the methods of preparing the carbon. The fibre of the grass, called "monkey bast," from South America, is stated



to be preferred. This fibre, or other vegetable fibre, is carbonised. The lamp is on the incandescent system, and is exhausted of air while the carbon is at a high temperature. The figures show some ways of arranging the lamps in the circuits and the connections.

3885. IMPROVEMENTS IN TELEPHONIC APPARATUS AND IN THE METHOD OF AND THE APPARATUS FOR TRANSMITTING ARTICULATE AND OTHER SOUNDS, *W. Morgan-Brown.*—*Dated 25th September*, 1880.—(*A communication from A. Graham Bell*) 1*s.* 4*d.*

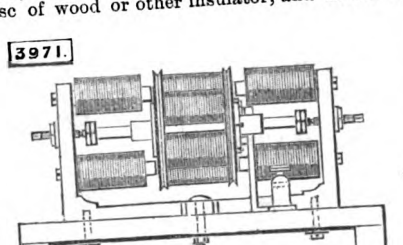
Fig. 1 shows the inventor's transmitting and receiving photophonic apparatus for the production of a musical sound. A ray from the sun is reflected from a plane mirror, A, into a lens, B, which brings it to a focus as shown. The passage of the rays at a certain point is interrupted by a perforated disc, C (see Fig. 2). As C is rotated the rays pass intermittingly through the holes in it, after which they are projected on to the lens D^1, where they are again brought parallel, and thence pass to the receiver E, a



thin disc of india rubber, F, in case G. This disc will be affected by the intermittent beams falling on it so as to produce sound-waves, which are conducted to the ear of the listener by a flexible tube, H. A condensing instrument, shown as a lens, I, is preferably used to concentrate the rays on F. By varying the velocity of C the rapidity of interruption of the beam is equally varied, and consequently the pitch of the sound. In this form the motion which causes the interruptions is continuously in the same direction.

3971. IMPROVEMENTS IN DYNAMO-ELECTRIC AND MAGNETO-ELECTRIC MACHINES, *A. M. Clark.*—*Dated September 30th*, 1880.—(*A communication from A. Niaudet and E. Reynier, of Paris.*)—(*Not proceeded with*).

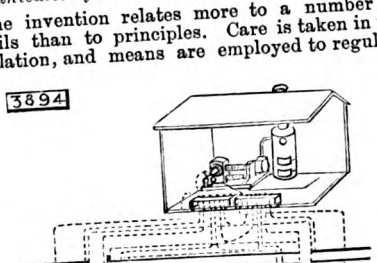
This invention relates to improvements in the original Niaudet machines, which are shortly as follows:—The fixed magnet, instead of being perpendicular to the axis of rotation of the coils, is in line with it. The ends of the core of the coils are connected by thin circles of iron, or a thin iron ring may be placed on the poles of the fixed magnet or magnets. The collector instead of being constructed of radial bars with intervening spaces, is composed of metallic segments fixed on a disc of wood or other insulator, and insulated



from one another, but close together. The figure shows the machine with two metal rings as described above.

3894. ELECTRO-MAGNETIC RAILROADS, *G. P. Jensen.*—*Dated 25th September*, 1880.—(*A communication from T. A. Edison.*) 1*s.* 6*d.*

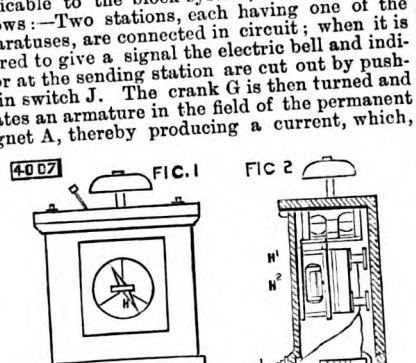
The invention relates more to a number of details than to principles. Care is taken in the insulation, and means are employed to regulate



the current used. There is a central station, insulated rails in sections, switches, and means of shunting as shown in drawing.

4007. IMPROVEMENTS IN MAGNETO-ELECTRIC APPARATUS FOR RAILWAY SIGNALLING, *G. Zanni.*—*Dated 2nd October*, 1880. 6*d.*

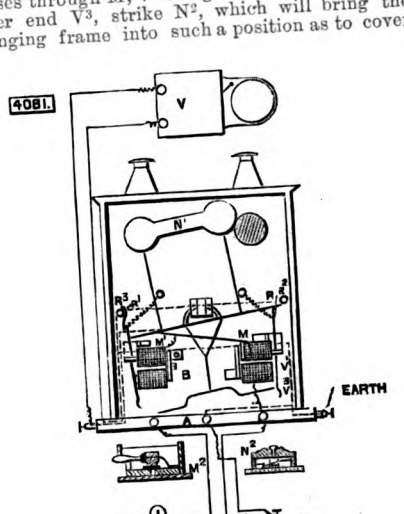
Figs. 1 and 2 are front and end elevations respectively of the apparatus. For producing the magneto-electric current the inventor makes use of an apparatus patented by him on the 13th of November, 1877. The invention is specially applicable to the block system, and operates as follows:—Two stations, each having one of the apparatuses, are connected in circuit; when it is desired to give a signal the electric bell and indicator at the sending station are cut out by pushing in switch J. The crank G is then turned and rotates an armature in the field of the permanent magnet A, thereby producing a current, which,



passing through the coils surrounding the magnet H^2, on needle spindle H^1, at the receiving station, causes said magnet and needle to rock in a direction according to the polarity of the current, and indicator being suitably arranged, the required signal is given. As soon as the signal is given and J released, the sending apparatus is ready to receive signals. To prevent accidental displacement of the needle after it has been adjusted to "line clear" or otherwise, the inventor makes the upwardly extending arm of H^2 of greater weight than the lower arm. He thus dispenses with any current in the line wire to retain the needle in position.

4081. ELECTRIC SIGNAL APPARATUS FOR RAILWAY PURPOSES, *W. R. Lake.*—*Dated 7th October*, 1880.—(*A communication from A. Lemaire and E Lebrun, of Paris*). 6*d.*

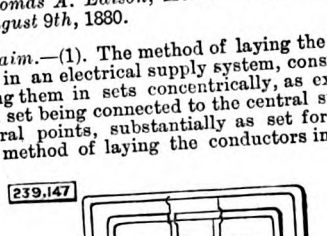
Fig. 1 shows the apparatus in elevation, with outer casing removed, connected with pusher-switch N^2, two-way switch M^2, and electric bell V. The apparatus consists of a board, A, carrying terminals as shown, and supporting vertical board B, on which are mounted two electro-magnets M and M^1 for operating the swinging frame N, suspended as shown, carrying double screen N^1 with discs as shown. The impulse to the swinging frame is imparted by the impact of armature V^1 on the end of N^2 when the pallets are under the influence of a current. Thus, when the parts are in the position shown, and a current passes through M, V^1 being attracted, will, by its other end V^3, strike N^2, which will bring the swinging frame into such a position as to cover



the red and uncover the white light, so indicating line clear. When a current passes through M, and the swinging frame is in position as shown, the pallet has no effect on it, but the current at the moment the pallet comes in contact with the soft iron core of the electro-magnets passes through the pallet, the upper part of which by means of small springs R is brought into contact with R^2, which communicates with the earth wire. This current in passing actuates the bell, which ceases to operate at the moment of contact of the springs R or R^1 with terminals R^2 or R^3, and the pallet is returned to its vertical position by the action of a small spiral spring. A current arriving at F in the switch M^2 serves to set the signals to indicate "train on line." A current arriving at O in same switch indicates "line clear."

239,147. SYSTEM OF ELECTRIC LIGHTING, *Thomas A. Edison, Menlo Park, N.J.*—*Filed August 9th*, 1880.

Claim.—(1). The method of laying the conductors in an electrical supply system, consisting in laying them in sets concentrically, as explained, each set being connected to the central station at several points, substantially as set forth. (2). The method of laying the conductors in an elec-



trical supply system, consisting in laying them in sets concentrically, as explained, each set being connected to the central station by several sets of branch conductors, and the various sets being connected to each other by several sets of coupler conductors, substantially as set forth.

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Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

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A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
Southampton-buildings, Chancery-lane

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SLIP

ELECTRIC LIGHT IN GLASGOW.—The Brush light was recently introduced into a large retail warehouse in this city.

WEST INDIES.—The cable between Trinidad and Demerara has been repaired, and communication is restored with British Guiana.

ELECTRIC LIGHT AT HAVRE.—The Société Générale d'Electricité have established eleven of the Jablochkoff lights in the harbour at Havre.

ACCIDENT FROM LIGHTNING.—Calcutta has been visited by a storm of unusual severity, during which three men were struck dead by lightning.

SWAN'S INCANDESCENT LAMP.—We hear that experiments have been made with this electric lamp on board H.M.S. "Inflexible," at Portsmouth.

BROOKS'S SYSTEM OF INSULATION.—We understand that satisfactory progress is being made with the work of extension of this system at Clapham.

THE STORNOWAY CABLE.—The cable between the mainland of Scotland and Stornoway in the Hebrides is repaired, and communication is now restored.

ROYAL INSTITUTION.—Last night Professor W. G. Adams read a paper before the Royal Institution on "Magnetic Disturbance—Auroræ and Earth Currents."

TELEGRAPH CLERKS' GRIEVANCES.—Meetings have been held at Glasgow and elsewhere, at which resolutions were passed strongly disapproving of the proposed schemes lately put forward.

OVERHEAD V. UNDERGROUND WIRES IN BOSTON.—The officials of the City of Boston, U.S.A., have refused to allow the Fire Department to carry its wires on poles across the Public Garden.

THE CITY GUILDS AND INSTITUTE.—The Prince of Wales has accepted the presidency of this society, and has promised to lay the foundation stone of the Central Institution at South Kensington.

THE ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).—The traffic receipts of this Company for the month of May last were £49,880, against £41,970 in the corresponding period of 1880.

MELBOURNE EXHIBITION.—We are informed that Messrs. Robey and Co., engineers, of Lincoln, have been awarded a first prize at the Melbourne International Exhibition for their portable engines.

DIRECT UNITED STATES CABLE COMPANY.—The estimated traffic receipts of this Company for May, 1880, amounted to £13,990, whilst for the same period of 1881 (at 2s. per word) they reached £16,630.

OVERHEAD WIRES.—Mr. Fawcett's attention having been called to the growing danger of the accumulated overhead wires in our large towns, he has replied that the matter rests entirely with the local authorities.

EASTERN EXTENSION COMPANY.—The traffic receipts of this Company for the month of May, 1881, amounted to £29,523, against £26,570 for the corresponding period of 1880, being an increase of £2,953.

THE TRANSVAAL.—The latest news from Pietermaritzburg says that no opposition is being offered to the reconstruction of the telegraph lines within the Transvaal, and that the work is being pushed on vigorously.

THE "JOURNAL OF THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS."—It is noticeable that every one of the abstracts appended to the May number of this *Journal* relate more or less directly to the "contact" theory.

THE TELEPHONE IN BERLIN.—A second central telephone office has been opened in this city at No. 74, Mauer-strasse, and there is some idea of opening a third office in the Post Office-buildings in Spandauer-Strasse.

THE TELEPHONE IN ILLINOIS, U.S.A.—The Central Telephone Company are about to establish a telephone exchange in Streator, Ill., which will be connected with two neighbouring cities, Ottawa and La Salle.

FRENCH PHYSICAL SOCIETY.—At the meeting of this society, on the 6th of May, M. E. Regnier described M. Faure's secondary battery, which he said was four times as powerful as a Planté battery of the same size.

ELECTRIC LIGHT IN INDIA.—It is stated that the Thakore of Morvee has introduced the electric light into his palace, and is making arrangements with a Bombay company to have the streets of his capital lit up with gas.

EASTERN TELEGRAPH COMPANY.—The Eastern Telegraph Company's traffic receipts for the month of May, 1881, amounted to £43,872, against £42,963 in the corresponding period of 1880, being an increase of £909.

THE FIRST MESSAGE BY THE MORSE.—The 24th of May last was the thirty-seventh anniversary of the day on which the first message was sent from Washington to Baltimore by Professor Morse with his well-known instrument.

ELECTRIC LIGHT AT MILAN.—On the occasion of the opening of the National Exhibition of Industry, Arts, and Commerce now being held in Milan the cathedral and the space before it was illuminated by four electric lamps.

THE BRUSH LIGHT IN PHILADELPHIA.—The Brush Electric Light Company propose to light Chestnut-street, Philadelphia from the Schuylkill to the Delaware rivers—a distance of two miles and a half—for one year for 5,000 dollars.

ROYAL UNITED SERVICE INSTITUTION.—The *Journal* of this Institution (No. CIX., 1881) contains, amongst other papers, that read by Mr. R. E. Crompton, "On the Progress of the Electric Light," in January last, with the discussion thereon.

THE TELEPHONE IN AMERICA.—The Bell Company are about to introduce their telephone into Atlantic City, New Jersey. The City Hall is to be connected with different points in the town, including the fire and police stations, and the principal hotels.

THE ST. GOTHARD TUNNEL CABLE.—This cable, which was manufactured at the works of Messrs. Felten and Guilleaume, of Mulheim on Rhine, cost 3·80 marks per metre (a mark is worth about one shilling). It was laid in an iron tube, covered with wood, aud fixed to the wall of the tunnel.

PRICES.—The prices as quoted are:—For gutta percha, per lb., genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d. For india rubber, per lb., fine Para 3s. 7d., negrohead 2s. 4d., central American 1s. 11d. to 2s. 6d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

CANADA.—Amongst the items of expenses incurred by the Dominion Telegraph Service for the year 1879-80, we find the following:—To Western Union Telegraph Company, one year's subsidy, 2,000 dollars; to Anglo-American Telegraph Company, for ditto, 1,946 dollars; California Electrical Works, for wires, 2,022 dollars; for Poles, 1,770 dollars.

THE MAXIM INCANDESCENT LAMP.—This lamp was exhibited at the Albany Works, 374, Euston-road, on May 27th. The lamps, to the number of 120, were fixed in various

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positions to show their utility as a light for domestic purposes, some being placed under water, &c. The exhibition of this light will, we understand, be continued until the end of June.

THE CUBA SUBMARINE TELEGRAPH COMPANY.—The number of messages passing over the lines of this Company during the month of May was 2,980, estimated to produce £3,000, against 2,540 messages, producing £2,972 in the corresponding month of last year. The traffic receipts for the month of March, estimated at £3,100, realised £3,124.

EARTHQUAKE SHOCKS.—A telegram from Naples, dated Tuesday night, says:—Last night shocks of earthquake were felt at the Observatory on Mount Vesuvius and at the villages at the foot of the mountain, especially at Torre del Greco. At nine o'clock this morning the sismographic activity was decreasing.—Severe shocks have also been felt at Murray Bay, in the province of Quebec, Canada.

GAS V. ELECTRICITY.—At the quarterly meeting of the Manchester District Institution of Gas Engineers, held at Buxton, on Saturday, the 28th of May, the president, in the course of some remarks, said that "he, as one having some experience in electric lighting, could say that it was only by the use of the most modern improvements in gas-making machinery that they could compete with the electric light."

NEW YORK ELECTRICAL SOCIETY.—The fifth meeting of this society was held on the 5th of May. Amongst the new members elected was a certain Miss Mettie F. Rowe. Resolutions of condolence with the family of the late Mr. J. N. Ashley, editor of the *Journal of the Telegraph*, were passed. A paper was then read by Professor H. S. Carhart of the North Western University, Evanstown, Illinois, on the "Fourth State of Matter."

MAGNETIC SURVEY OF MISSOURI.—Mr. F. E. Nipper writes as follows to *Nature* of the 26th May:—"Although our State Legislature absolutely refused to do anything to aid in the magnetic survey of Missouri the work will still go on. A gentleman of St. Louis, whose name is withheld at his own request, has assumed the entire expense, and we shall now begin a more minute examination of the Missouri, Grand, and Osage Valleys."

MR. LUKE'S PAPER ON FIELD TELEGRAPHY.—There were present at the reading of this paper before the Society of Telegraph Engineers, on the 26th inst., an unusual gathering of military men, among whom we noticed General Mansell, Colonels Champane, Webber, Schaw, Malcolm, and Woodthorpe; Majors Armstrong, Hamilton, and Wynn. Messrs. Josephs, Kink, Duthy, and Pitman, of the Indian Telegraph Department, besides Mr. Luke himself, were also present.

ROYAL SOCIETY.—On Wednesday night the second *soirée* of the season, known as "Ladies' Night," took place at the Royal Society, a large number of guests being present. Amongst other apparatus exhibited was Professor Hughes's type-writer, a large induction coil, giving a spark of eighteen inches, shown by Mr. Apps, Professors Reinhold and Rückers' apparatus for testing the electrical conductivity and resistance of the film of a soap bubble, Mr. Crooke's tubes of radiant matter, &c.

CONSOLIDATION IN AMERICA.—In the Pennsylvania Lower House, the bill to prevent consolidation of the telegraph companies in that State is well on for the second reading. An agreement is said to have been signed by the officers of the Western Union Telegraph Company and the president of the North Western Telegraph Company for a lease of the latter's lines. This company has its eastern terminus in Chicago, from whence its lines extend to the principal cities and towns of Wisconsin, Minnesota, and out into Dakota territory.

NEW TELEPHONE.—A very interesting experiment with a new molecular telephone, invented by Robert M. Lockwood and his son, William, of New York, was, says the *Operator*, tried recently between New York and Philadelphia, over the ordinary telegraph wires. Conversation, even to a whisper, in Philadelphia was heard with perfect distinctness of articulation. The principle claimed by the inventors is that of molecular disturbance and the suppression of all vibration. A company has been formed to put the new telephone in practical use.

OBITUARY NOTICE.—The *Journal of the Telegraph*, of New York, records the death of its editor, Mr. J. N. Ashley, who died on the 26th of April from the effects of a chill. He was for many years a telegraph clerk, and is said to have been in the Boston (U.S.A.) office when Professor Hughes tested his instrument by an unbroken circuit from Boston to New Orleans and back to Halifax and Boston, which was at that time considered an extraordinary distance. Later on he became connected, editorially, with the *Telegrapher*, which subsequently merged into the present *Journal of the Telegraph*.

IRIDIUM.—The Portland (Oregon) *Standard* says that, about two years ago a gentleman who was examining a collection of specimen minerals and gold quartz in the office of Mr. S. M. Lyon, an assayer, obtained permission to take away several specimens, among which was a quantity of the fine sand and "blowings" of gold which contained the black and shining particles that most miners are familiar with, and which have been regarded as particles of iron. These specimens were taken East and proved to be iridium. It is found mixed with gold in Oregon, and appears as a black shining sand, in particles a little coarser than blasting powder. There are portions of this State and the adjoining territory where the metal may be found in abundance.

SWAN'S LAMP ON AN ATLANTIC LINER.—The Inman steamer "City of Richmond," which recently arrived at New York, had on board Mr. Bates, electrician, and his staff, who went over to note the working of the Swan incandescent lights, with which the ship's cabin was illuminated during the voyage. The main saloon was lighted by six lamps, comprising thirty jets, and eleven others were distributed at various points on board, making seventeen in all. Some of the state rooms were similarly illuminated. The light is described by those who observed it during the voyage as very steady and mellow, not subject to fluctuation or accident, easily managed, and very brilliant. The six lamps in the main saloon rendered the apartment as light as day, enabling passengers to read at any point.

SWAN'S LIGHT IN LONDON.—On Friday last Messrs. J. Edmundson and Co., gas engineers and electricians, in accordance with arrangements made with the Swan Electric Light Company, exhibited at their establishment in Great George-street, Westminster, Swan's incandescent lamp. The electricity was generated by means of a four-horse steam engine, estimated to be sufficient for 25 lights. The lamps were arranged in various rooms, and the ease with which they are switched on or off demonstrated. Opaline and other globes were used, some of which concealed gas and others electric lights, the two kinds being undistinguishable from each other without a close examination, the effect being to meet the objection so frequently urged against electric lighting of painful whiteness or brilliancy.

ELECTRIC LIGHT IN LIVERPOOL.—The British Electric

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Light Company are actively carrying out the preparations for lighting the principal streets of this city with the Brockie lamps, 60 of which, as we announced in our issue of the 9th April, will be used to light about two miles and a half of streets. The lamps are each said to give a light equal to 2,000 candles. The estimated cost of lighting is 2·69d. per lamp per hour for 3,620 hours, or about £2,600 per annum. The present lights will displace 245 gas lights, the cost of which for the same number of hours per annum is £1,288, but they give a total lighting power far inferior to the electric light. If the company succeed as well in Liverpool as they have done at Cannon-street Station, the new light should be a great boon to the people of that great city.

Another Telephonic Boon.—The interesting facts related by Major Hamilton at the last meeting of the Society of Telegraph Engineers (a report of which will be found in another column) deserve to be described more at length. It seems that in the experiments mentioned the Tyler sounder is used as a species of telephonic transmitter, a Morse key acting as the speaker, the signals of which, separated into vibratory currents by the sounder, are gathered up at the distant end by an ordinary telephone. A permanent current has, of course, to be maintained. The musical note emitted by the vibrating armature of the Tyler sounder is reproduced in the telephone in defiance of earth, water, or even breakage, if the severed ends touch conducting material. This is a most valuable discovery for military telegraphy of the rough and ready sort, but it is likely also to prove useful in other quarters.

Accidents by Lightning.—A car driver was killed by lightning on Thursday week at Llandudno, in Wales. After a vivid flash he was seen to roll off his seat. When examined by the doctor shortly afterwards the left side of the face was found to be discoloured, the hair being slightly singed. The horse was struck on the hind quarters, and had to be destroyed. On Saturday a violent thunder storm occurred in Scotland, and over a great portion of England. At Cambuslang the lightning entered a house by the open door, and struck a man and his two children. The man died shortly after, but hopes are entertained that the two children will live. The man was struck in the head and shoulder, which became quite black. At Stonehouse, in Scotland, the lightning struck a house, knocking the furniture all about, but hurting none of the inmates. At Rosendale, in Lancashire, a man was struck dead by the lightning; whilst at Accrington, two young men were thrown from the trap in which they were driving, and were so injured as to be unable to continue their journey.

Mascart's Electrometer.—At the meeting of the French Physical Society on the 1st April last, M. Mascart described an electrometer, the readings of which are inscribed by photography by aid of the extreme sensitiveness of "gélatino-bromure" paper. The electrometer used is the Thomson, with a plane mirror, the case of the apparatus carrying a plane-convex lens. The rays reflected on the plane side of the lens cause a line to appear on the paper, which corresponds to the zero of the apparatus. The light is produced by a small gazogene lamp. The photographs exhibited by M. Mascart gave evidence of the truth of the statement put forward by him that the potential of the atmosphere is higher and more regular at night than in the day. M. Mascart also drew the Society's notice to the advantage of using small magnets for magnetic apparatus, and showed a bifilar, the needle of which was but from five to six centimetres long. The magnet carried a concave mirror of 50 centimetres focus, and an ivory scale, divided into ½mm., was placed in the focus of the mirror. Observations were made with a telescope regulated to infinity; 10″ can also be read. These small apparatuses have very little influence on one another, which is a boon in magnetic observations.

The New Atlantic Cable.—A special despatch to the New York *Herald*, dated Canso, N.S., May 19th, says:—"The representatives of the American Cable Construction Company arrived here this afternoon, to witness the landing of the shore end of the new American cable. The steamer "Faraday," with 1,000 miles of the new cable on board, is hourly expected, when the laying of the cable will begin. A commodious building for the accommodation of the staff of the station has been erected near the shore, and a trench seven feet deep and half a mile long has been opened. Everything is in readiness to receive the cable. There is much excitement among the citizens of Canso and the vicinity at the prospect of having a cable station located here." We announced last week that this 1,000 miles of cable had been successfully laid, and that the "Faraday" was on her way home for the other portion, which the promoters hope to have laid and the whole cable in working order by the middle of next month. The *Operator* says that a sister cable will be laid soon; this, however, we believe to be very problematical.

Stopping Press Telegrams.—The *Standard* of Saturday says:—"Our Tunis correspondent telegraphed to us yesterday as follows:—I have just been summoned to the telegraph office to receive the price of thirteen messages not duly forwarded. On inquiring whom I might hold responsible for this omission (my telegrams having been accepted here without comment, and receipts given), I was told the telegrams were despatched hence, but stopped at Paris by order." The *Standard* adds:—"If the explanation given by the Tunisian telegraph officials to our correspondent be the correct one, we have nothing to say, except to congratulate the French Republic on the incident, which is worthy of the best (or worst) days of the Second Empire." In the House of Commons on Tuesday last, Sir C. Dilke stated that no information had reached the Foreign Office as to the alleged suppression in Paris of thirteen telegrams sent from Tunis by the correspondent of a London newspaper. It was, the hon. baronet added, doubtful whether the circumstance was a violation of the Telegraphic Convention. That Convention gave power to any country to stop private telegrams which might appear dangerous to the security of the country, and another article gave power to intercept the whole of the telegrams if necessary, though not without notice to the other country concerned.

Legal.—The cases of W. S. Williams *v.* the Western Union Telegraph Company, and Rufus *v.* the same, were heard in New York on the 13th May, before Judge Truax. The counsel for plaintiff, Mr. R. Sewell, shortly after having opened the case, complained that he was too ill to continue, and the case was, therefore, adjourned to a future date. Both suits were brought for the same purpose, viz., to restrain the Western Union Company from issuing 15,526,590 dollars of its increased capital stock to its present stockholders on account of dividends which those stockholders would have received if the surplus earnings of the company since 1866 had not been invested in real and personal property. The injunctions already granted restrain the Union Trust Company and the Western Union's directors from assisting in the distribution of such a stock dividend. Immediately after Chief Justice Sedgwick made his injunction order some time ago, the Western Union Company, acting under the advice of counsel, issued to its stockholders, through the Union Trust Company, certificates of

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indebtedness in lieu of the shares of stock which it was restrained from issuing. This proceeding was the ground of motion to punish the defendants for contempt. In connection with this trial the *Operator* publishes a letter written prior to the 13th May, by a Mr. J. F. Pierce, partner with Mr. Sewell, the counsel for plaintiff, which runs as follows:—

"New York, April 28, 1881.

"MY DEAR SENATOR: The telegraph people have industriously circulated a report that there was to be a decision of the W. Un. to-day. My partner, Mr. Sewell, says it is a libel on the Court, who offers to bet two to one that decision will not be made to-day, and when it is made it will not be in favour of the Co.

"Faithfully yours, "JAMES F. PIERCE.

"Hon. A. S. Paddock."

Mr. Sewell would certainly have won his bet with regard to the first part of his letter, by retiring ill; the second remains to be proved.

THE LINEMAN.—

A merry life the lineman leads,
Although a restless soul;
Untrammelled by the ties of place,
He roves from pole to pole.

Serene, aloft, in every storm,
Though never known to boast,
He twines his leg around an arm,
And sticks right to his post.

The common ills that vex mankind,
Of whatsoever shape,
Afflict him not; for him, at least,
There's always some escape.

In vain may grim and grizzly Want
Her bony finger point;
Though famine reign on every hand,
He still can find a joint.

And when his crosses multiply,
As they will do in time;
He simply packs his pliers up,
And seeks some other climb.

At last he meets some gentle maid,
Exceptionally nice;
Then, scorning pompous phrase, he says,
"Come, let us make a splice."

Resolved his vices to discard
And no more faults to find;
To cultivate, in homely joys,
A calm, contented mind.

So glide his days on pleasant lines,
All toil and trial past,
Through mellow years, until he finds
The perfect ground at last.—*Operator.*

THE ACTINIC BALANCE.—This name, says *The Times*, has been given provisionally by Mr. S. P. Langley, of Allagheny Observatory, to an instrument he has devised for measuring radiant energy, and which is far more sensitive, prompt, and accurate than the best thermopile. Its principle is as follows:—Suppose two equal wires to pass from a battery to a differential galvanometer, conveying equal currents, one of which tends to move the needle to the right, the other to the left; the needle, thus solicited, remains at zero. If now a ray of some source of radiant energy of higher temperature than the wires fall on one of them, the wire becomes heated, and therefore a worse conductor than before; hence less current passes through that wire and the needle is deflected. It was important to get a surface, for exposure to the radiation, which would have great electric resistance, would show a considerable change of this for a given change of heat, and would take up and part with heat very quickly. Steel, platinum, and palladium are found the most available metals. Mr. Langley has used fine strips of steel, rolled to the extraordinary thinness of 1-300 to 1-500th mm., in which state 8,000 to 12,000 sheets laid one on the other will make but about one inch. Two or more of these, less than half an inch long, and 1-20th of an inch wide, are placed side by side in circuit in a small cylinder open at one end, which can be directed to the source of radiant heat. The current used does not warm the strips as much as 5deg. C. above the surrounding temperature. The instrument is stated, roughly, to be five to 100 times as sensitive as the most sensitive thermopile the author possesses. Mr. Langley gives some examples of its delicacy. Among others, a series of 18 measures of the heat of the moon taken in an hour and a half (under diverse conditions) on November 12, 1880, with the equatorial of the observatory, using a 13-inch achromatic lens and a smaller condensing lens near the focus. The mean deflection was 41·6. Mr. Langley has been engaged in measurements of nearly homogeneous rays of heat in the diffraction spectrum. His experiments thus far prove the absence of any *maxima* in the spectrum; also that the actual solar energy (as it reaches us) is nearly at its *minimum* precisely where the so-called "actinic curve" is at its *maximum*. Further, the *maximum* of heat is found to be not in the ultra-red, but in the orange, while the curve of heat approximately agrees with that of light.

NEW TELEPHONE TRANSMITTER.—The *Scientific American* describes a new telephone transmitter by Mr. E. Berliner, of Boston. The principal feature of the invention is the disposition of the carbon contact surfaces, one being attached to the diaphragm, the other being supported by a metal socket attached to a hinged plate secured to an arm that projects from the back of the mouthpiece downward over the diaphragm. This arm serves the double purpose of supporting the free carbon electrode and clamping the diaphragm in its place against the back of the iron mouthpiece. The diaphragm is bound around the edges with soft rubber, and is separated from the mouthpiece by a ring of pasteboard. The iron mouthpiece is hinged to a casting fastened to the circular box which contains the induction coil and supports the binding screws for the battery, line, and ground wires. To the front of the induction coil is attached a plate connected with the battery wire, and carrying a spring having in its free end a screw which bears against a spring connected with the centre of the diaphragm, and acts as a dampener as well as a conductor, through which the current passes to the carbon electrode at the centre of the diaphragm. The battery current enters at one of the binding screws, passes through the primary wire of the induction coil, through the spring and carbon electrode at the centre of the diaphragm, through the hinged electrode, metallic mouthpiece and its hinge, and back through a binding screw to the battery. The variation of the current in the primary circuit occurs at the contact of the two carbon electrodes, the contact being varied by the vibration of the electrode attached to the diaphragm. When the transmitter is used for long distance telephony, the pendant carbon electrode is made heavier, to reduce resistance in the local current and to amplify the electrical undulations. The terminals of the secondary wire of the induction coil are connected with the two remaining binding screws, which are connected, one with the ground and the other with the line, in the usual way. The accessory devices connected with this transmitter may be of the usual character. It will operate well with any of the well known forms of receiver, and is easily managed and thoroughly efficient. This transmitter has been well introduced, and large numbers of them are being used in Europe. They have been adopted on several of the leading German railways, and are extensively used in the German postal service. They are the property of the American Bell Telephone Company.

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THE RADIOPHONE AND THE VOICE.

On former occasions we have drawn attention to the excellent researches of M. Mercadier, to whom is chiefly due the evidence in support of the great part played by heat rays in the sonorous effects observed by Professor Bell. He has shown, like Mr. Preece, that the effects obtained by Professor Bell on exposing to intermittent radiation a diathermanous envelope containing gas are due to the vibrations of the gas, and not of its envelope; that their intensity is increased when the wall is coated with an absorbent material, like lampblack; that they are due chiefly to the action of the red rays; and that the rays are transformed into sound by a process like that producing vibrations in sounding pipes. It followed that a glass tube enclosing a gas in contact with a thin plate of smoked mica exposed to the intermittent beam will constitute a veritable *thermophone*.

With this simple contrivance M. Mercadier has reproduced a continuous scale of musical sounds reaching a pitch of 2,000 vibrations per second. Moreover, like Professor Bell, he has also succeeded in obtaining articulate speech from this receiver. This was done by a device like the photophone transmitter of Professor Bell, and the vibrating light was focussed by a lens, and received in the mouthpiece of the receiver described. An india rubber hearing tube carried the sound to the ear. The sounds are most distinct with the electric light and sunlight, the latter giving very distinct effects. On passing the beam through a solution of alum the sounds could still be faintly heard, as also they could on passing it through a thin plate of ebonite 25 millimetres thick. Even plates of zinc, copper, aluminium of $\frac{1}{10}$ or $\frac{1}{20}$ millimetre thick interposed in the path of the beam gave very feeble results.

ELECTRIC RAILWAYS AND TRANSMISSION OF POWER BY ELECTRICITY.*

BY ALEXANDER SIEMENS.

(CONCLUDED FROM PAGE 28.)

About three years ago, Sir William Armstrong erected a turbine at his country seat, Craigside, near Newcastle, and drives by it a Siemens dynamo-electric machine, the current of which is conducted to his residence about half a mile distant from the waterfall. In day time this current transmits the power of the turbine to the house, where it is used for various purposes, and at night it is converted into light by means of "Swan" lamps, of which it works between thirty and forty. This application deserves special mention, because it was one of the earliest examples of transmission of power by electricity for practical and permanent purposes.

In the same way Dr. Siemens utilises some dynamo machines at his country house near Tunbridge Wells, the power to drive the primary machines being, in this case, obtained by means of a Tangye "Soho" steam-engine. The waste steam from the engine is utilised to warm the hot houses, and the gardener attending the houses takes also care of the steam-engine and the dynamo machines driven by it. In this way the cost of fuel and of attendance is reduced to a minimum.

The electric current is utilised during the whole of the night to produce two lights, by the influence of which various fruits and plants are growing; and the current, in daytime, from one machine sets in motion a similar machine, which works the chaff-cutter, and some other machinery, at the farm about a quarter of a mile away from the hothouses. The current from the other machine is conducted to the pumping-house, a distance of about half a mile, and the secondary machine there has supplanted a small vertical steam-engine that used to pump the water up to the house. In this case, the return conductor is formed by the wire fence, care being taken to connect the wires from one side to the other of the intervening gates.

By these arrangements, one man at the farm can do the work of three; and, instead of a man having to drive a steam-engine at the pumping-station, to say nothing of transporting coals there, and losing time in getting up steam, he can set the pump in motion without going near the place, an occasional visit only being required for refilling the lubricators.

There are many similar instances in which it is advantageous to connect a number of small machines which work at irregular intervals by means of the electrical transmission of power with one steam-engine, not only when the distance between the machines is considerable, but also when they are comparatively close together.

Several applications of the latter nature have been made at Messrs. Siemens's works at Charlton; among others the apparatus for testing the mechanical strength of cables is set in motion by a dynamo machine; and a small pump, which keeps the water in circulation in the core-tanks, is driven by another machine. In both cases it would have been more costly to transmit the necessary power in the usual way by shafts and belting. A few months ago a machine was placed upon a crane on the wharf, and it was found that by it a ton could be lifted about 12 feet per minute, and smaller weights proportionately quicker. It is only fair to add that the crane was not constructed for the purpose, and that the arrangement was made more with the view to demonstrate the possibility of working cranes by electricity than to obtain the best results.

The electrical transmission of power, on account of the compactness of the machines, and the ease with which the conducting cables can be shifted, is particularly adapted to be used in cases where the driven machinery is erected only for temporary purposes. As an example, it may be mentioned that, when the cable ship "Faraday" was last at the works of Messrs. Siemens, the machinery by which the cable is pulled on board was driven part of the time by a dynamo-electric machine.

Another illustration of the same kind was furnished by M. Felix, of Sermaize-les-Bains (Marne), who worked, in June, 1879, one of Howard's double-furrow ploughs by a Gramme dynamo machine. The motion was conveyed from the electrical machine to a drum, and thence by a coil of wire to the plough. There was no stoppage of any kind, but the plough did its work steadily, digging up the ground to the depth of about eight inches. In the following year, M. Felix showed at the local agricultural exhibition at Bar-le-duc a plough and a threshing machine, both worked by electrical transmission of power with perfect success.

As mentioned above, one of the first thoughts of Dr. Werner Siemens was to employ dynamo-electric machines for working elevated railroads, but it was only about three years ago that he was induced to take the matter into serious consideration, by the owner of a coal mine asking him to design a locomotive to draw the coal waggons in the mine. The result was that Messrs Siemens and Halske showed at the Berlin Exhibition, in the summer of 1879, the model of an electric railway, which has since been exhibited at Düsseldorf and Brussels, and is at present working in the Crystal Palace. The total length of this circular railway was at Berlin 300 metres, and the gauge one metre. A dynamo machine, mounted on a carriage by itself, served as locomotive, and the passengers were conveyed in three carriages, each having seats for six persons. The current was conveyed from the primary machine to a rail laid between the rails on which the carriages run; thence it was taken off by brushes fixed to the machine and sliding on the centre rail, it returned to the primary machine by the outer rails. When the carriages were prevented from moving, the locomotive exerted a pull of about 4 cwt. (200 kilos) on them; and when the train was in regular motion the pull varied between 1½ cwt. and 1¾ cwt. (70-80 kgr.), which represents, as the speed was about 10 feet (3 metres) per second, three-horse power.

Small as the railway was, it clearly demonstrated that such a mode of transport is feasible; and the advantages of having light carriages, of being able to propel them without noise and smoke, induced Messrs. Siemens and Halske to lay before the authorities in Berlin a plan to make an elevated railway through one of the streets in Berlin, altogether about 6¼ miles (10 kilom.) long.

Along the kerbstones of the street, iron columns, formed by two-channel irons, were to be erected, about 11 yards apart, carrying wooden sleepers on top, which, in their turn, support longitudinal girders. To ensure the stability of the structure, wooden struts keep the girders apart, and serve, at the same time, to insulate them from each other. The clear height, from the level of the street to the under side of the girder, is about 14ft. 6in. (4·4 metre), and the depth of the girder about 16in. (40 cm.). Steel rails are laid on top of the girders, and the girder and rail on one side serve as the conductor from the primary machine, and the other rail and girder form the return wire; in this way the electrical resistance of the line is reduced to a very low figure.

The gauge of the line was to be one metre, and the carriages, resembling ordinary tram-cars, were to be about 5′·5″ broad (1·65 m.) and 8 feet (2·46 m.) high above the rails. The dynamo machine, placed out of sight, underneath the car, imparts the motion by means of belts to the two wheels, which have to be insulated from each other, as the current arrives through one rail, passes through the machine, and returns by the other rail as described above.

The speed at which these carriages were intended to travel is 30 kilometres (18·6 English miles), and ten of them were to be supplied for the railway, of which six would be in use, and four in reserve, 10h.-p. being required to drive the primary machine of each carriage. The cost was carefully worked out, and, as it

* Paper read at the Society of Arts on May 18th.

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serves as an indication what such railways may be expected to cost, a short summary of the principal items will not be out of place.

FIRST COST OF 10 KILOMETRES (6¼ MILES), ELEVATED RAILWAY, SINGLE LINE.

Railway itself, including 10 stations	£61,000
Ten carriages, to hold 15 persons each	3,150
Stationary steam engine and dynamo-machine..	1,950
Buildings	1,185
Land	4,500
General expenses	715
	£72,500

or about £11,600 per mile.

This estimate includes the cost of erection of the railway, and of the station, at which the steam-engine works, together with the necessary buildings to protect the rolling stock against the weather, when it is not used. The cost of working the railway was calculated to be, for one year:—

CURRENT EXPENSES.

Wages	£2,190	
Fuel	1,110	
Oil and waste	50	
Lighting	80	
		£3,420

DEPRECIATION AND REPAIRS.

Three per cent. on £62,500 (railway and buildings)	£1,875	
Sixteen per cent. on £5,000 (carriages and machinery)	800	
		£2,675

INTEREST ON CAPITAL.

Five per cent. on £75,500	£3,625
Total cost per annum	£9,720

or about £4 6s. per English mile per day.

The intention was to run about 200 trains per day, and if the charge of 1d. per mile had been made, the £4 6s. per mile could have been earned, if on the average five or six persons had been conveyed in each case. The concession for this railway was not granted, partly because the inhabitants strongly objected to having people looking into their first floor windows, and partly because the Emperor did not wish to see "The Linden," which this electric railway was to cross, disfigured.

Subsequently Messrs. Siemens and Halske obtained permission to build a railway on the ground level from Lichterfelde, a suburban station on the Berlin-Anhalt Railway, to the Military Academy, and this railway has just been successfully opened for regular traffic. It is a single line of 1 metre gauge, a little over 1½ English miles long. The permanent way has been constructed in exactly the same way as that of railways; wooden sleepers and steel rails are employed, the rails being connected, in addition to the usual fish plates, by short straps of iron, bent in the shape of a bridge, so as to admit the adjustment of the rails to different temperatures, and to reduce, at the same time, the electrical resistance. As the currents are low tension currents, it was not necessary to provide further insulation, and no difficulty is experienced in using one rail as the positive, and the other as the negative conductor.

About a third of a mile from the Lichterfelde station the primary machine, with its steam-engine, is erected in the engine-house of the waterworks, and the current is conveyed from there to the rails by underground cables. The car is exactly similar to an ordinary tram-car, and is constructed to hold 20 persons besides the guard. It is symmetrical, and can move backward and forward, each end being provided with a starting lever for the guard, a brake handle, and a signal-bell. The dynamo machine is placed underneath the car, and transmits its movement to the wheels by means of spiral steel springs. The tires of the wheels are insulated from their axles, and are in electrical connection with brass rings fastened on the axles, but insulated from them. Contact brushes press against these brass rings, and from them the current is conducted to the dynamo machine, and sets it in motion.

The authorities were, for some time, doubtful how to class this novel railway, and after long deliberation they have decided to rank it as a one-horse tram-car. In consequence of this decision, the average speed on the railway must not exceed 9·3 English miles (15 kilometres) per hour, and the greatest speed at any moment must not exceed 12·4 English miles (20 kilometres) per hour. The time for traversing the whole distance is, therefore, not to be less than ten minutes, although the car could make the journey in about half the time with perfect safety.

If the railway continues to work in a satisfactory manner it is to be extended, and there is no doubt that the success of the railway at Lichterfelde will greatly assist in the further introduction of electrical railways, either on the level of the streets, or elevated, like the steam railways of New York. Over any other system, worked by steam or by compressed air, the electrical has the advantage that no heavy machinery has to be carried about to set the train in motion. The carriages can, therefore, be built in a lighter manner, thus reducing the power necessary to move them, and permitting all bridges and other superstructures to be built more cheaply than usual. Several carriages, each with a dynamo machine, can be joined to one train, and by this distribution of the motive power much steeper inclines can be overcome than when the same train is drawn by a single locomotive.

In addition to the ordinary brakes, means can be provided to short circuit the machines on the carriages, and to cause them in this way to act as very powerful brakes. The use of large stationary engines reduces the amount of fuel necessary to develop a certain power on the travelling carriage, and if waterfalls can be utilised, the cost of working these railways will be further diminished. It seems, therefore, probable that such railways can be usefully and economically constructed to facilitate the traffic in crowded streets, or in situations where local circumstances favour their application.

From all that has been done during the last few years, it is quite evident that the art of transmitting power by electricity has advanced rapidly, and that its practical application is continually gaining ground. This, however, should not be regarded as a sign that the electric transmission will supersede every other system of transmitting power to a distance, but rather that there is a sphere for it, where it meets existing demands better than our present means; and it should, therefore, not be treated as an enemy of existing systems, but as a supplement to them, by the aid of which problems can be solved, that could not otherwise be attempted.

ELECTRICITY AT THE ROYAL ACADEMY.

There can be no doubt that we are under an obligation to bring before our readers the relations of our great subject, electricity, to natural phenomena. Now, we take it that when a phenomenon has by a great number of reliable observers during thirty years been discovered to have a periodicity depending in some way on the motions of a planetary body, it may safely be regarded as a natural phenomenon, and of this kind is the exhibition at the Royal Academy. When we first proposed to ourselves the consideration of the important subject of this article it was natural to look for that famous account of a more famous chapter by the learned Slawkenbergius on a somewhat similar subject given in the annals of the Shandy family. We refer to what is the most interesting treatise on a biological subject that we have ever met with, the chapter on the "Snakes of Iceland."

Unfortunately, in the days of Yorick no one dreamt of writing an index, and when one begins to look for a particular reference, dipping in here and there, the chances are that one forgets altogether the business one came about, and settles down for the day to a steady enjoyment of the adventures of my Uncle Toby. As we have not found this reference, the only help given us by the learned writer above-mentioned is the suggestion that we begin and finish our treatment of the present subject by the statement, "There is no electricity at the Royal Academy." But it strikes us that this would be a very off-hand way of treating a great subject. For, after all, the exhibition is, as we have proved already, a natural phenomenon, and has it not been asserted over and over again by popular lecturers that electricity enters into every occurrence in nature? If electricity is the all-pervading agent which we think it to be, surely our subject is far more important than those which have already been taken up by our contemporaries. "Geology at the Royal Academy," "Meteorology, Astronomy, and Physiology at the Royal Academy," or, to come to more technical subjects, have we not articles on "Cookery," as exhibited in the unnumbered room entered from Gallery II., "Sign Painting," as illustrated more or less on all the walls, and "Coach Building," which is to be studied in the quadrangle? It is unfortunate that the education of artists has hitherto been so incomplete that they cannot comprehend the magical actions which go on in any electrical appliance. Any object becomes a subject of artistic contemplation only when the artist is capable of understanding it, or, as Carlyle would say, when he gets a glimpse of the soul of it; but the spirit that presides over the working of a telegraph instrument, the genius that rushes to Yokohama and San Francisco at the bidding

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of a stupid Aladdin, that rides in the thunderstorm, and thickens the oil in watches—this spirit is still invisible to the materialistic, decorative artists of Burlington House. In the days of Sesostris artists made for him paintings and sculptures of triumphal entries into Thebes. From the 10th to the 15th centuries were produced those living pictures of mediæval spiritualism, saint worship and chivalry, the agent of all good work in those days; and in like manner, whenever, at any time, real works of art have been produced, we find that the artists were men who entered more fully than their contemporaries into the spirit of the age. Now, if we except one of Turner's pictures in the National Gallery, and an abominable one in which another steam engine appears, exhibited this year at the Paris Salon, no modern artist has made any attempt to illustrate the great agencies of civilisation in the nineteenth century, the magical forces of Nature governed by man. To re-animate dead mediæval spiritualism, to imitate Dutch painters whose souls were rich in enthusiasm for spiritual and political freedom, to copy artists of the newly open-eyed age of Pericles, this was bad enough two hundred years ago; but when, instead of pandering to the decorative taste of the Court of Louis Quatorze, it is done mainly for the Lancashire market, we feel that the Royal Academy Exhibition is a phenomenon which we have a right to be proud of, a symbol of the importance of house decoration, but something which has nothing whatever in common with old ideas of art. It is the habit of men of this century who spend mornings with Ruskin in rapt contemplation of the masterpieces of Giotto and Lippo Lippi, and of those others who believe in peacock's feathers and sage green, to sneer at the steamship, the railway, and the telegraph, the forces that make possible the building of a mighty city like London, and give to "every peasant a fowl in his pot." They are the onlookers they say, and see the most of the game—and so was the Indian who tried to lasso a railway train. Now, let us accept the fact that there is no artist who has a spiritual insight into heat and electricity. Is it not possible, since the line of modern artists is that of decoration, that some of them should begin to prepare the fringe for the coming prophet's mantle? Technical education is not altogether wanting in this matter, and the professors are Japanese. We have before us some exquisite little Japanese envelopes. One of them has a stayed telegraph post, supporting four line wires at an angle, which cut obliquely across the paper; but if one asks oneself why it seems so impossible that an English artist should introduce such an object into one of his pictures without spoiling it, one can give no reason for what is certainly a fact. The sketch conveys ideas which a photograph could not give; it means something more than so many pieces of wire and wood; it hints at the whole story of the magic of electricity, we do not know how. Is it because there is a little chattering sparrow sitting on one of the wires, emblematic of the unthinking human animal? Is it because the wires are suddenly cut off by the edges of the paper, bringing up before us the idea given by the swallow as it darted from sunlight to sunlight through the smoky hall of the Vikings, an idea of life and the eternities? We do not know, but the fact remains that this prosaic thing, rejected by English artists, has become in the hands of a man of more imagination the most perfect ornamentation imaginable for the envelope of a love-letter.

Again, how often have we seen a railway train brought in artistically by the Japanese. They do not alter much the colours or the shapes of cranks and chimneys, but somehow they make a work of art—they put into the picture an idea of the magical nature of the performances of the steam engine. To these artists it is not merely the magnificent cryptomaria and the red-beamed temples and the white cone of their sacred mountain that is artistic, nor do they rest satisfied with depicting the imaginary animals of an earlier age. To them the articulated railway train as it sweeps through the country at night is a veritable fiery dragon, not less wondrous because it is a friendly animal, and electricity does not get prosaic when it becomes the familiar servant of humanity.

THE JABLOCHKOFF SYSTEM IN CHANCERY.

On May 27 Vice-Chancellor Bacon had before him the case of "Werdermann *v.* the Société Générale d'Electricité." The plaintiff, Richard Werdermann, claimed to be the inventor of certain improvements in electric lighting apparatus, and his statement of claim set out that letters patent, dated the 12th December, 1876, and numbered 4,805, for such invention, were duly granted to him. On the 24th October, 1877, the plaintiff assigned to MM. Marie Louis Denayrouze and Camille Marcilhacy, in consideration of £1,000, his interest in the letters patent, and the assignees covenanted with the plaintiff that in case the patent should be infringed in any way they would defend the same. They also covenanted, so long as the patent could be profitably worked, to use their best endeavours to introduce the electric lighting apparatus into use in Great Britain and Ireland and elsewhere, and the plaintiff was to receive 5 per cent. on all the profits made out of the invention. This assignment was made with the view of a company being formed to work the patent, and accordingly Messrs. Denayrouze and Marcilhacy promoted a company, which was incorporated on the 19th March, 1878, under the style of the Société Générale d'Electricité, and Messrs. Denayrouze and Marcilhacy executed a deed transferring to the company the legal right to the patent. The invention was subsequently used by the defendant company on the Thames Embankment and elsewhere in London under the title of the duplex Jablochkoff system of electric lighting. Plaintiff thereupon wrote to Messrs. Denayrouze and Marcilhacy complaining of what he called the infringement of his patent by the defendant company, and in reply received a letter stating that he would duly receive the 5 per cent. on the profits, if any, and that that was all he could demand under the deed of October, 1877. Plaintiff had, however, failed to obtain any account from his assignees, and now asked for an account from the Société Générale d'Electricité.

The statement of defence set out the following as the circumstances under which the plaintiff had obtained the letters patent claimed by him:—On the 23rd March, 1876, M. Jablochkoff obtained in France letters patent for a certain system of electric lighting, and, wishing to protect his invention in England, he, on the 11th September, 1876, deposited in the Patent Office here a provisional specification of his invention. Within two or three months after that time M. Jablochkoff made a new discovery, by which his previous invention was considerably improved, and on the 6th February, 1879, he deposited in the Patent Office a fresh specification, with a new application for a provisional protection. He proceeded with his second application, and obtained letters patent dated the 6th February, 1877, and numbered 494, under the title of "Improvements in Electric Lamps and in Arrangements connected therewith for Dividing and Distributing the Electric Light." Jablochkoff believed that by such letters patent he had protected the invention described in his previous specification, but the plaintiff, whose process claimed by his letters patent of the 12th December, 1876, was a mere imitation of the first discovery, and Jablochkoff contended that the latter had, by his subsequent specification and patent, abandoned his earlier specification, and given the plaintiff a right to the benefit of the same. The defendants had for some time past been and were now carrying on a very extensive business in Paris, in which they used the process and name of M. Jablochkoff, and in consequence of the reputation which he had acquired in connection with his inventions his name formed part of the title under which the defendants were incorporated in France, their correct titlebeing the "Société Générale d'Electricité, procédés Jablochkoff." They had acquired from M. Jablochkoff many important patents, and the plaintiff's patent, if valid at all, was by no means the most important. The patent of the 6th February, 1877, was of much greater importance and value, as it mentions and protects the means of obtaining a subdivision of light which was not in any way secured or claimed by the plaintiff's patent. Defendants did not admit the user by them of the plaintiff's invention on the Thames Embankment under the title of the Jablochkoff system of electric lighting. As to the plaintiff's claim for an account of profits, they replied that the accounts relating to the work of his patent in England had been produced to him, and showed that they had made no profits from such working.

The plaintiff brought his action against the defendant company without including Messrs. Denayrouze and Marcilhacy, and upon a stop made immediately on the issuing of the writ, Vice-Chancellor Bacon granted an injunction until the trial of the action to restrain the defendants from carrying out an agreement which they had entered into with a new company called the Electric and Magnetic Company (Limited), for the sale to the latter company of (amongst others) the plaintiff's patent. The case now came before the Court upon a motion by the plaintiff for leave to amend the pleadings by adding the names of MM. Denayrouze and Marcilhacy.

Mr. Higgins, Q.C., and Mr. Joseph Smith appeared for the plaintiff; Mr. Horton Smith, Q.C., and Mr. Grosvenor Wood opposed on behalf of the defendants.

After a prolonged discussion his lordship made the order as asked, and on a summons as to taking the accounts directed that the chief clerk should proceed on the accounts already delivered by defendants. The costs of these applications to be costs in the cause.

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ELECTRIC RAILROADS.

At a recent lecture before the Society of Arts some confident predictions were made as to the probable use in the future of electricity as a means of transmitting the motive power necessary for railroad work. A feather indicates the way the wind blows, and there is a something well understood but incapable of definition which indicates to scientific and practical men new developments and new applications of scientific truths. An application is tried in the laboratory, it is shown and explained to scientific friends, it forms the subject of a paper, and is criticised by some one or other of the societies, it is tried and succeeds on a moderate scale, no one flatly denounces it, most agree there is something in it but that the time for its full development is not yet ripe, and thus the scheme becomes part of the work of the world. A suggestion here and an improvement there bring the idea within the domain of practical engineering. The world is richer, and a complete step has been made in the progress of civilisation.

The history of electric railroads is following this well-beaten course. The feasibility of such a railroad was discussed at the Paris Exhibition in 1867, but the apparatus in use was not then sufficiently perfect to admit of conclusive experiment. The impetus that was given to the improvement of dynamo and magneto-electric machines by the rapid progress of the electric light soon enabled Dr. Werner Siemens to put his ideas to the test. In 1879, at the Berlin Exhibition, a small model electrical railroad was laid and worked by Messrs. Siemens and Halske. Last year a similar railroad was to be seen at the Exhibitions at Dusseldorf and at Brussels, and according to the recently-issued summer programme of the Crystal Palace, this electric railroad is satisfactorily at work in the gardens on the upper terrace, near to the centre of the Palace. Since the first of these model railroads was tried, several modifications tending to simplicity have been made, and these introductions will have a fair trial in the experimental line of a mile and a half in length, built at Berlin, and opened during the past month.

Another fact that tends to show the thoughts of those conversant with electrical matters, is that several patents have been taken out for apparatus connected with electric railways. Mr. Edison is one of the first in the field, and has obtained a patent for an invention intended "to furnish an economical and reliable system of electro-magnetic railways or tramways, which, while useful in any locality, shall be particularly adapted in regions where the traffic is too light for ordinary steam railways, or where the main bulk of the traffic is limited to certain seasons, or where the difficulties or expense of grading render ordinary steam roads impracticable."

Suppose, for an instant, we admit that electrical railroads are already to a certain extent within the domain of practical engineering, we must admit also that at present steam is in possession of the trunk roads, and likely to remain so. Where is the best place to test the capabilities of electricity in this direction? We incline to the opinion that it may soon gain extensive use, for example, in factories which have railway sidings. Take, as an instance, that great biscuit factory of Messrs. Huntley and Palmer at Reading. The whole factory is permeated with tramway lines, a very small part of which are worked by steam, horse power and man power being largely used. Now, with the stationary engine power at command, and the dynamo machines placed in the most advantageous positions, the greater part, if not the whole, of this work could be performed by electricity. It is a waste of power to employ a steam engine to pull or push a light truck, and it is seldom that a very heavy load is required to be moved.

Another example of places where electricity might be advantageously employed is that of small country stations with tram-lines to feed the railway, like that constructed by the Duke of Buckingham from a small station (Quainton-road), on the railway joining Buckingham and Aylesbury, through his property to Brill. This feeding line was at first worked by horse power, though we believe it is now worked by a steam engine, and it has proved very convenient to the farmers of the district. It is an experiment which might with advantage be tried, whether a stationary engine with the necessary electrical apparatus could not as effectively do all the work of the branch line; the power, during the intervals of train work, being used by the farmers in the adjacent farms for chaff or turnip cutting, cake grinding, &c. Of course, when water power can be obtained there must necessarily be a field for the introduction of electricity.

It is not our intention at present to discuss the difficulties which still have to be overcome before electricity can be used for railway work. The question of insulation, however, will soon prove itself to be either an insuperable difficulty, or will be passed by as of little importance. We shall be careful to keep our readers fully acquainted with the progress made, because, if electricity meets with but moderate success in this new sphere, the capital that will be required for its introduction will amount to millions of pounds.

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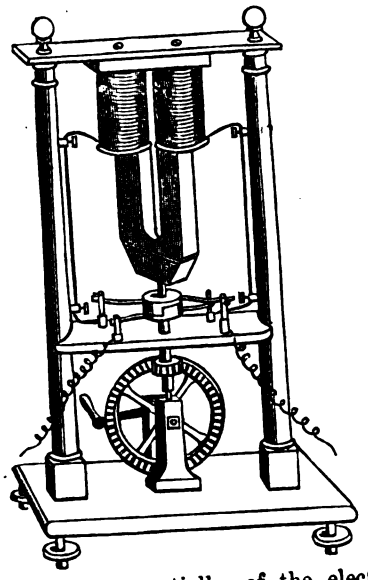
THE EVOLUTION OF DYNAMO AND MAGNETO ELECTRIC MACHINES.—III.

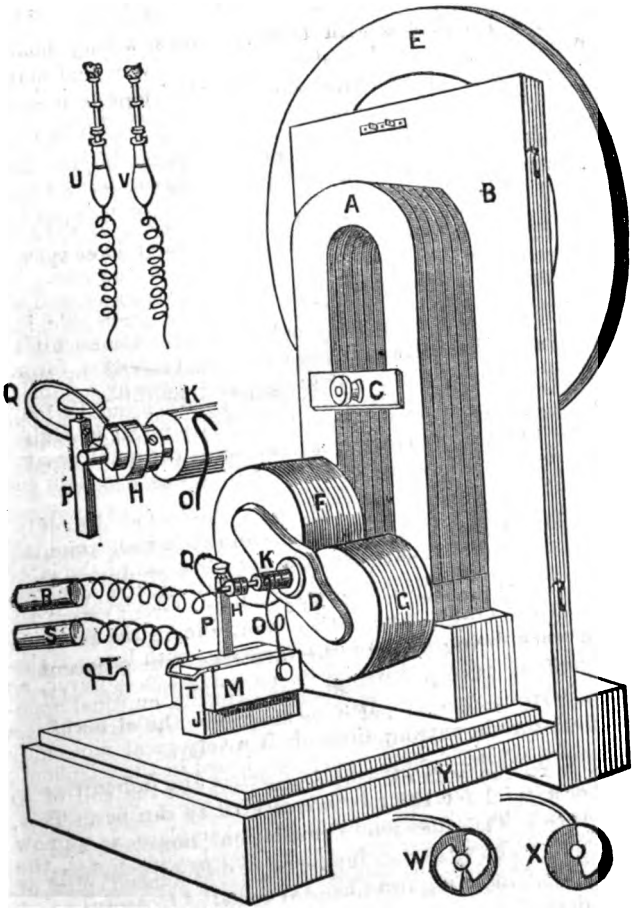
By γ. β.

(CONTINUED FROM PAGE 297, VOL. VI.)

Faraday's discovery was destined soon to bear fruit, and although, as we have shown, he himself designed the first magneto-electric machine, the honour is generally given to Pixii. It was in 1832 that Pixii designed the machine illustrated below.



This machine consists essentially of the electro-magnet as shown, which is stationary, while a magnet of horse-shoe shape is rotated by means of a spindle and a pair of bevel wheels. The rotation of the magnet causes its poles to pass successively



before the poles of the electro-magnet, and thus a current is induced in the wire of the coils. This current, according to the theory we indicated in our second paper, depends entirely upon the number of lines of force cut at each half revolution of the magnet, and as these are comparatively few the machine is not very efficient. The current obtained by the rotation of the magnet passes into the conducting wires parallel to the standarde, and alternates in direction. A commutator is used to obtain a current constant in direction. An improvement on Pixii's machine was made by Saxton in 1833, but the improvement was carried still further by Mr. Clarke, whose machine we illustrate. Mr. Saxton fixed his compound horse-shoe magnet horizontally, and rotated electro-magnets as armatures at the ends of the horse-shoe magnet. This was undoubtedly an advance upon Pixii, inasmuch as the field of force cut by the armature was more intense, and the mass to be rotated lighter. Mr. Saxton's machine is described and illustrated by Mr. W. H. Preece in his recent edition of Noad's *Students Text-Book of Electricity*, pp. 313—316. Pixii's machine was followed by that of Mr. E. M. Clarke, a description of which will be found in the *Philosophical Magazine* for October, 1836. It is also very fully described in Sturgeon's "Annals of Electricity," vol. I., pp. 145 to 155, since when a more or less lengthy description has been given by most authors of electrical works. The illustration and description given here are taken from Sturgeon's "Annals of Electricity." During the time which elapsed between the account of this machine given in the *Phil. Mag.* and that published in the "Annals," several improvements were made, and the machine had taken the form now to be described.

"A is the battery of bent bar magnets, placed *vertically* and resting against four adjusting screws, which pass through the mahogany back board B. C is a bar of stout brass, having an opening in the middle, through which passes a bolt with a screw wheel, the purpose of which is to draw the magnetic battery to the board B. By these means the battery can readily be disengaged from the machine without taking asunder the entire apparatus, and the battery is thus also freed from that vibration which must necessarily be occasioned by the attachment of the rotating apparatus to the battery itself. D is the intensity armature, which screws into a brass mandril seated between the poles of the battery A, motion being communicated to it by the multiplying wheel E. This armature has two coils of fine insulated copper wire, 1,500 yards long, coiled on its cylinders, the commencement of each coil being soldered to the armature D, from which projects a brass stem (also soldered into D), which carries the break pieces H and H. The break piece is made fast in what position soever is required, by a small binding screw, K and K, a hollow brass cylinder, to which the terminations of the coils F G are soldered, being insulated by a piece of hard wood attached to the brass stem. O and O are iron wire springs, pressing against the hollow cylinder K at one end, and held in metallic contact by a nurled head-screw in the brass strap M, which is fixed to the side of the wooden block L P and P, a square brass pillar fitting into a square opening in the other brass strap N, and secured at any convenient height required. Q and Q, a metal spring that rubs gently in the bread piece H, and held in perfect metallic contact by the nurled head screw in P T and T, a piece of copper wire for connecting the two brass straps M, N; then D, H, Q, P, N are in connection with the commencement of each coil, and K, O, M with the terminations."

The construction of these machines should be noticed carefully, so that the changes in construction of more recent machines may be made quite clear. In Pixii's machine the permanent magnet revolves. In Clarke's machine the permanent magnet is fixed. In Pixii's machine, as already stated, the lines of force from the ends of the magnet are cut at each half revolution. In Clarke's, the lines of force from the poles of the magnet—point not quite at the end—or, we might say, lines of force from the centres of magnetic action, are cut at each half revolution. The number of lines of force cut in the latter case are more numerous by far than in the former, and hence, viewed from this point alone, Clarke's machine is a decided improvement on that of Pixii.

THE BLISS TELEPHONE SIGNAL APPARATUS.

At the Chicago Telephone Convention, the Bliss Individual Signal Apparatus was exhibited by the Telephonic Signal Corporation, of New Bedford, Mass. *The Operator* says:—

"To those familiar with the telephone, no argument is needed to show the advantages of an individual signal, by which the station desired is called and the bells at all other stations left undisturbed. To accomplish these results many devices have been produced. Some of them are good, some indifferent, some very bad. Some are 'marvels as mechanical and scientific curiosities, but totally unfit for the purpose intended. Some are mental visions that could not be materialised in metal.'

"The Bliss Individual Signal apparatus is simple in construc-

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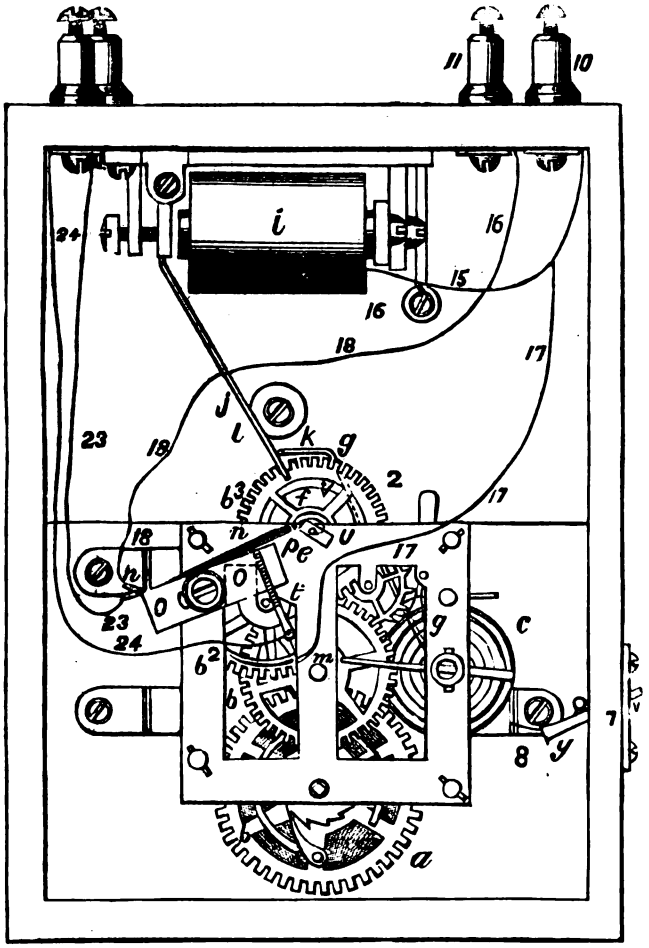
tion, rapid in action, and safe and satisfactory in results. Fig. 1 shows the box open, exposing a small train of clock-work, the necessary connection wires, and an electro-magnet, from the armature of which extends an arm to trip the catch from the balance-stop and start the clocks.

"Binding posts 10 and 11 are the line posts, the two left hand posts being connected with the shunt in the clock, and the outside wires from these posts are to be connected one on each side of receiving coils of the magneto bell.

"When an electric current from any station is thrown over the line, it passes through the magnet *i* at each station, which attracts the armature, causing the arm *j* to strike the lever *k*, the end of which rests against a stop on the balance-wheel shaft. The balance-wheel having been stopped in a position that strains the hair-spring, the instant the lever is removed from the balance-stop the clock at each station starts, the pointer making one revolution around the dial-plate. The lever *k* is prevented from again engaging the balance-stop for the period of one minute, during which time the one revolution of the pointer is made.

"The small lever *y* with spring 8 (Fig. 1) is for the purpose of starting the clocks if from any reason the pointers have stopped out of their proper position, which is directly at the top of the dial.



"The divisions of the dial are numbered. As the pointer passes into each division the bell at the station represented by that number is automatically thrown into the circuit and continues so until the pointer has passed that division. Thus station 2, for instance, can be rung up only while the pointer is passing division 2 of the dial-plate, and at that time no other station can be rung up."

MOLECULAR MAGNETISM.*

BY PROFESSOR D. E. HUGHES, F.R.S.

(CONCLUDED FROM PAGE 23.)

2. Influence upon the Molecular Structure of an Iron or Steel Wire by Electricity or Magnetism.

Being desirous to modify the apparatus already described, so that it would only give indications of a current if they were of a spiral nature, the wire was kept rigidly at its zero of strain or torsion, and the coil was made so that it could revolve on an axis perpendicular to the wire; by this means, if the wire was free from strain, the centre or axis of the coil would coincide with that of the wire. Thus, with a straight copper wire, we should have a complete zero; but if this wire formed a right or left-handed helix the coil would require moving through a given degree (on an arbitrary scale) corresponding to the diameter and closeness of the spirals in the helix. The degrees through which the coil moved were calibrated in reference to known copper helices. 50 degrees equalled a copper wire 1 millim. diameter, formed into a helix of 1 centim. diameter, whose spiral turns were separated 1 centim. apart.

In order to obtain a perfect zero, and wide readings, with small angular movement of the coil, it is necessary that the return wire should be of copper, 2 millims. diameter, offering comparatively little resistance, and that it should be perfectly parallel with the steel or iron wire. In order that it may react upon the exterior of the coil, it is fastened to the board, so that it is near (1 centim.) the exterior of the coil, and parallel to the iron wire, at a distance of 4 centims. If we consider this return wire alone, we find, as in the sonometer, that if the wire is perpendicular to the exterior wires of the coil, we have a zero or silence, but moved through any degree, we have a current proportionable to that degree; by this means, we have an independent constant acting on the coil, constantly aiding the coil in finding its true zero, and allows of very wide readings, with a comparatively small angular movement of the coil.

The rheotome is joined to a battery of two bichromate cells, and by means of a reversing switch, an intermittent current of either direction can be sent through the wire. The telephone is joined direct and alone to the coil, thus no currents react upon the coil when perpendicular to the iron, and its return wire, if not of a spiral nature.

Placing an iron wire 0·5 diameter, and passing a current through it, I found a change had taken place similar to those indicated in my paper of March 17th; but it was so difficult to keep the wire free from magnetism and slight molecular strains that I preferred and used only in the following experiments tempered steel wire (knitting needles I found most useful). All the effects are greatly augmented by the use of iron wire, but its molecular elasticity is so great that we cannot preserve the same zero of reading for a few seconds together, whilst with steel, 0·5 millim. diameter, the effects remained a constant until we removed the cause.

I have not as yet been able to obtain a steel wire entirely free from magnetism, and as magnetism in steel has a remarkable power over the direction of the spiral currents, I will first consider those in which I found only traces. On passing the intermittent current through these, the sounds were excessively feeble for either polarity of current, but at each reversal a single loud click could be heard, showing the instant reversal of the molecular polarity. The degree of coil indicating the twist or spirality of the current was 5 degrees on each side of its true zero. The wire was now carefully magnetised, giving 10 degrees on each side for different currents, the positive entering at north pole, indicating 10 degrees right-handed spiral, negative entering the same pole, a left-handed spiral. We here see in another form, a fact well known and demonstrated by De la Rive by a different method, that an electric current travels in spirals around a longitudinal magnet, and that the direction of this spiral is entirely due to which pole of an electric current enters the north or south pole. I propose soon, however, to show that under certain conditions these effects are entirely reversed.

If through this magnetised wire I pass a constant current of two bichromate cells, and at the same time an intermittent one, the spiral is increased to 15 degrees, but the direction of the intermittent current entirely depends on that of the constant current. Thus, if the positive of the constant current enters the north pole, the intermittent positive slightly increases the spiral to 17 degrees, and the negative to 13 degrees, both being right-handed. The two zeros of the constant battery are, however, as we might expect from the preceding experiment, on equal opposite sides of the true zero; but if we magnetise the wire whilst a constant current is passing through it a very great molecular disturbance takes place, loud sounds are heard in the telephone, and it requires for each current a movement of the coil of 40 degrees, or a total for the two currents of 80 degrees. This, however, is not the only change that has taken place, as we now find that both constant currents have a right-handed spiral, the positive under which it was magnetised a right-handed spiral of 95 degrees, the negative a right-handed spiral of 15 degrees, and the true central or zero point of the true currents indicates a permanent spiral of 55 degrees.

This wire was magnetised in the usual way, by drawing the north pole of my magnet from the centre to one extremity, the south from the centre to the other, and this repeated until its

* Abstract of a Paper read before the Royal Society.

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maximum effects were obtained. In this state I found, sliding the coil at different portions, that the spiral currents were equal and in the same direction throughout.

It now occurred to me to try the effect of using a single pole of the magnet; this was done whilst a constant current was passing through the wire, commencing at the extremity, where the positive joined, drawing the north pole through the length of the wire, from positive towards the negative. The effect was most remarkable, as the steel wire now gave out as loud tones as a piece of iron, and the degree on the coil showed 200 degrees. The constant and intermittent currents now showed for either polarity a remarkably strong right-handed twist; the positive 200 right, and the negative 150 right-handed spirals; the molecular strain on its wire from the reaction of the electric current upon the molecular magnetism was so great that no perfect zero would be obtained at any point, a fact already observed when a wire was under an intense strain, producing tertiary currents that superposed themselves upon the secondary. In order to compare these spiral currents with those obtained from a known helix, I found that taking a copper wire of similar diameter (0·5 millim.), and winding it closely upon the steel wire ten turns to each centimetre, having a total of 200 turns, with an exterior diameter of 1·5 millims., withdrawing the steel wire, leaving this closely wound helix free, that it gave some 190 degrees, instead of the 200 of the steel wire alone. Thus the spiral currents fully equalled a closely wound copper wire helix of 200 turns in a similar length.

If it were possible to twist a magnetised wire several turns to the right, and that its line of magnetism would coincide with that of the twist, then on passing a positive or negative current, there would be an apparent augmented or diminished spirality of the current, but both would have a right-handed twist. The result would be identical with the phenomenon described, although the cause is different.

The explanation of this phenomenon can be probably found in the fact that the constant spirality now observed is that of the electric current under which it was magnetised, for whilst magnetising it we had a powerful source of magnetism constantly reacting upon the electric current, and the constant spirality now observed is the result or remains of a violent molecular reaction at the instant of magnetisation, and the remaining evident path or spiral is that of the electric current. On testing this wire as to its longitudinal magnetic force, I found it was less than a wire simply magnetised in the usual way. Thus the effects are internal, affecting the passage of the electric current, giving, however, no external indications (except apparent weakness) of the enormous disturbance which has taken place.

If, instead of drawing the north pole of the magnet as above, from positive towards negative, I draw it from negative to positive, all the effects are repeated, except we have now, as we should expect, a left-handed spiral, but if I draw the magnet from the extremities of the wire to the centre, then at this centre I find an absolute zero of twist, but on each side a contrary twist, the wire then having a left and right-handed twist, the positive travelling towards the centre in a right-handed twist gradually ceasing in zero. This is as we might expect, but if done under the influence of a constant current, no matter what pole of the battery enters afterwards the north pole of the magnet, it will have during its first half a right-handed, and its second a left-handed spiral. It became important to know if a wire which had been magnetised under the influence of a current could be restored to something like its original condition. Electric currents had no effect. Heat, which would not destroy its temper, had no effect. Mechanical vibrations and torsions failed to disturb the molecular arrangement; but by magnetising it strongly by a magnet, when no current was passing, at once brought the wire to its usual apparently rigid state, and the constant or intermittent currents now indicated only 18 degrees of spiral currents against a previous 200 degrees, and the sounds were, as usual from steel, excessively weak. I have since used this method with invariable success, when I wished to preserve or repeat the experiments upon the same wire. If these experiments are repeated upon an iron wire, the effects are far greater in the first instance, so great that they were thrown out of the range of my measurements. It was only after a few seconds of successive reversals that the zero of the wire was brought within range, and although these rapidly decreased, exactly similar effects were observed as in the steel, and as with all moderate ranges, I could bring the iron at once to a complete zero by torsion, and as torsion alone would produce this complete zero, I believe we have here effects from identical causes to those related in the first chapter.

Having noticed in my previous papers the increased molecular activity caused by the approach of a powerful permanent magnet, and believing that the permanent spirality above mentioned was due to this alone, and not to an increased polarity, I magnetised strongly an iron wire giving as usual a reversed spiral for different currents of but 10 degrees. I now heated the wire by a spirit flame to a dull red heat, whilst the current was passing through it, and on cooling I found a similar but stronger permanent torsion of 250 degrees, both currents, as in the previous experiments, having a right-handed spiral. Thus a current of electricity passing through a wire that is nearly red hot, determines the molecular arrangement, or path, which on cooling forces currents of either direction to follow the path which had been determined under the influence of heat.

3. Molecular Sounds.

The passage of an intermittent current through iron or other wire gives rise to sounds of a very peculiar and characteristic nature. Page, in 1837, first noticed these sounds on the magnetisation of wires in a coil. De la Rive published a chapter in his "Treatise on Electricity" (1853) on this subject, and he proved that not only were sounds produced by the magnetisation of an iron wire in an inducing coil, but that sounds were equally obtained by the passage direct of the current through the wire. Gassiot, 1844, and Du Moncel, 1878-81, all have maintained the molecular character of these sounds. Reis made use of them in his, the first electric telephone invented, and these sounds have been, since the apparation of Bell's telephone, often brought forward as embodying a new form of telephone. These sounds, however, for a feeble source of electricity, are far too weak for any applied purposes, but they are most useful and interesting where we wish to observe the molecular action which takes place in a conducting wire. I have thus made use of these sounds as an independent method of research, and by their means verify any point left doubtful by other methods, some of which I have already described.

The apparatus was the same as in the last chapter, except that no telephone was used. The intermittent electric current was connected by means of switch key, either with the coil inducing longitudinal magnetism in the wire, or could be thrown instantly through the wire itself. Thus rapid observations could be made of any difference of tone or force by these two methods. A reversing key also allowed, when desired, a constant current of either polarity to pass through the wire under observation.

Iron, of all metals that I have yet tried, gave by far the loudest tones, though by means of the microphone I have been able to hear them in all metals. But iron requires no microphone to make its sounds audible, for I demonstrated at the reading of my paper, March 31st, that these sounds with two bichromate cells were clearly audible at a distance. A fine soft iron wire (No. 28) is best for loud sounds to be obtained by the direct passage of the current, but large wires (1 millim.) are required for equally loud tones from the inducing coil. By choosing any suitable wire between these sizes we can obtain equal sounds from the longitudinal magnetism or direct current. The wire requires to be well annealed; in fact, as in all preceding experiments, the sounds are fully doubled by heating the wire to nearly red heat. There are many interesting questions that these molecular sounds can aid in resolving, but as I wish to confine the experiments to the subject of the two preceding chapters, I will relate only a few which I believe bear on the subject.

On sending an intermittent electric current through a fine soft iron wire we hear a peculiar musical ring, the cadence of which is due to that of the rheotome, but whose musical note or pitch is independent both of the diameter of the wire and the note which would be given by a mechanical vibration of the wire itself. I have not yet found what relation the note bears to the diameter of the wire; in fact, I believe it has none, as the greatest variation in different sizes and different conditions has never exceeded one octave, all these tones being in our ordinary treble clef, or near 870 single vibrations per second, whilst the mechanical vibrations due to its length, diameter, and strain vary many octaves.

I believe the pitch of the tone depends entirely upon molecular strain, and I found a remarkable difference between the molecular strain caused by longitudinal magnetism and the transversal or ring magnetism produced by the passage of a current; for if we pass the current through the coil, inducing magnetism in the wire, and then gradually increase the longitudinal mechanical strain by tightening the wire, the pitch of the note is raised some three or four tones (the note of the mechanical transversal vibrations being raised perhaps several octaves). But if we tighten the wire during the passage of an electric current through it, its pitch falls some two or three notes, and its highest notes are those obtained when the wire is quite loose. A similar but reverse action takes place as regards torsion; for if the wire is magnetised by the coil we obtain an almost complete zero of sound by simply moving the torsion index 45 degrees on either side, and as this was the degree which gave silence in the previous experiments for the same wire, it was no doubt due to the same rotation of its polarised molecules. If we now pass a constant current through

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the wire whilst the intermittent one is upon the coil, we hear augmented sounds, not in pitch but loudness, and if we give torsion of 45 degrees to one side we have silence, or nearly so, whilst the other side it gives increased tones which become silence by reversing the battery. If, whilst the wire by torsion has been brought to zero, we decrease or increase the mechanical longitudinal strain, then at once the polarised molecules are rotated, giving loud sounds; and we further remark that when the wire is loosened, and we again tighten it, we gradually approach a zero, and on increasing the strain the sounds return. Thus we can rotate the molecules by a compound strain of torsion and longitudinal strain.

If we wish to notice the influence of a constant current passing through the wire under the influence of the intermittent current in the coil, we find that if the wire is free from torsion that, on passing the current, the tones are diminished or increased according to the direction of the current. The tones then have an entirely distinctive character, for whilst preserving the same musical pitch as before the tones are peculiar, metallic, and clear, similar to when a glass is struck, whilst the tones due to longitudinal magnetism are dull and wanting in metallic *timbre*. If we now turn the index of torsion upon one side we have a zero of sound with or without the current; but the opposite direction gives increased tones whilst a current is passing through the wire, but zero when not. Here again a peculiarity of *timbre* can be noticed, as although we have loud tones due only to the action of the current through the wire the *timbre* is no longer metallic, but similar to that previously given out by the influence of the coil. Evidently, then, the metallic ring could only be due to the angular polarisation of the molecules, and when these were rotated by torsion the tones were equally changed in its action upon the wire.

I have already shown that a permanent magnet brought near the wire could rotate its polarisation, and it can produce sound or silence in these molecular sounds (during the time the wire is at its zero of torsion, and a constant current sent through the wire as in the last experiment). We find that either pole of the natural magnet has equal effect in slightly diminishing the sound by an equal but opposite rotation from the line of its maximum effects; but if the wire is brought nearly to zero by torsion, then on approaching one pole of the natural magnet we produce a complete silence, but the opposite pole at once rotates the molecules to its maximum loudness, and on taking away the magnet we have comparative silence as before.

Heating the wire to nearly red heat by a spirit lamp increases the tones of longitudinal magnetism induced by the coil some 25 per cent., but it has a much more marked increase on the tones produced by the direct passage of the current where they have more than 100 per cent. increase, and if we pass the intermittent current through the coil and constant through the wire, we find no direct rotation of the molecules by heat. Although an apparent rotation takes place if we by the required torsion first place the wire at its zero, then on the application of heat faint sounds are heard, which become again almost silent on cooling. This is simply due to the diminution by heat of the effect of the elastic torsion.

Tempered steel gave exceedingly faint tones, requiring the use of the microphone; but on magnetising with a constant current, inducing spiral magnetism, the sounds become audible, some 15 degrees sonometer against 175 degrees for iron. Thus the molecular rigidity of steel as observed by previous methods was fully verified.

I have mentioned only a few of the numerous experiments I have made by the three methods described, all of which, however, bear directly upon the molecular arrangement of electric conducting bodies. I have selected a few bearing directly upon the subject I have chosen for this paper.

I have, I believe, demonstrated by actual experiments which are easy to repeat, that—

1. An electric current polarises its conductor, and that its molecular magnetism can be reconverted into an electric current by simple torsion of its wire.
2. That it is by the rotation of its molecular polarity alone that an electric current is generated by torsion.
3. That the path of an electric current through an iron or steel wire is that of a spiral.
4. That the direction of this spiral depends on the polarity of the current or that of its magnetism.
5. That a natural magnet can be produced, having its molecular arrangement of a spiral form, and consequently reversed electric currents would both have a similar spiral in passing through it.
6. That we can rotate the polarised molecules by torsion or a compound strain of longitudinal and transversal.
7. That the rotation or movements of the molecules give out clear audible sounds.
8. That these sounds can be increased or decreased to zero by means that alone have produced rotation.
9. That by three independent methods the same effects are produced, and that they are not due to a simple change or weakening of polarity, as when rotation has been incomplete a mere mechanical vibration has at once restored the maximum effect.
10. That heat, magnetism, constant electric currents, mechanical strains and vibrations, have all some effect on the result.

In presenting these results to the Royal Society, I desire simply to draw attention to the effects that molecular action can produce in its relations to electricity and magnetism, and it seems to me that a knowledge of the molecular actions taking place is a necessary step previous to knowing what magnetism is in itself.

PHYSICAL SOCIETY.—May 28, 1881.

PROFESSOR FULLER, V.P., IN THE CHAIR.

Wave Motion.

Mr. C. Woodward exhibited apparatus for illuminating wave motions to a class. This consisted of a number of glass panes of equal size, mounted on stands so that they could be ranged in a line or in rank and file. Patches of blue paper were attached to them to represent the moving particle of the wave, the positions being determined by a diagrammatic card which fitted each pane. A machine for showing Fresnel's conception of polarised light consisted of two axles fitted with a number of cranks, which supported a roof of rafters bearing at their ridges a number of beads to guide the eye in tracing the wave motion. By turning the axles the cranks shifted the frame of rafters, and the beads displayed the wave motion, which was vertical, eliptical, or circular, according to the adjustment.

Velocity of Light.

Professor G. Forbes explained the experiments made by him and Dr. Young to determine the velocity of light. The method employed was that of Fizeau; but instead of having one distant reflector, and observing the total eclipse of the reflected ray by a tooth of the revolving wheel, two reflectors, one a quarter of a mile behind the other, were used, and two rays, which were observed when of equal brightness. This method was found more accurate than Fizeau's own plan, and gave curves of brightness. The speeds of the toothed wheel were adjusted until the two rays appeared of equal brightness. The general result was that the velocity of the light of an electric lamp is 187,200 miles per second. Corner found the light of a petroleum lamp to be 186,700 miles per second, and Michaelson that of the sun to be 186,500 miles per second. The higher number of Professor Forbes is probably due to the bluer light of electricity, for further experiments made with coloured lights and the spectrum seemed to prove that blue light travels probably over 1 per cent. faster than red light. The experiments were made at Wemyss Bay in Scotland.

Mr. Spottiswoode, F.R.S., said he had followed Professor Forbes with interest, and these results appeared to modify our ideas of the luminiferous ether.

Lord Rayleigh inquired why it was that Jupiter's satellites showed no difference in tint in emerging from eclipse if red and blue rays travelled with unequal velocities; and

Professor Forbes believed it due to the gradual character of the emergence of the satellites from behind their primary. According to the new theory variable stars should, however, be bluish with an increase of their light.

Professor G. C. Foster pointed out that dispersion of the light in the air would rather have had the effect of retarding the blue rays.

Hall's Experiments.

Mr. Hall, of Baltimore, U.S., then exhibited the experiment in which a current of electricity flowing longitudinally along a thin foil of metal is caused to yield a transverse or lateral current by inserting the foil between the poles of a magnet. The lateral current is observed on a sensitive galvanometer, and care is taken in the first place to find points of connection with the foil which yield no current before the magnet is applied. The results were that if iron is called + the series is iron +, silver —, gold —, platinum —, tin —, and, curiously, nickel, though a magnetic metal like iron, is —; but on inquiry of Professor Chandler Roberts it proved that the nickel employed was, perhaps, impure. Cobalt ranges between iron and silver, and is + like iron.

Professor Perry suggested that the displacement and huddling

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of the lines of flow of the current by the magnet might cause the current; but

Mr. HALL said that an experiment had been tried to test that, and went to prove that it was not due to crowding of these lines.

The SECRETARY read a paper by Professor J. H. Poynting, on the change of bodies from the solid to the liquid states. There are two types of change, exemplified by ice-water and by sealing-wax, in the one a surface melting at the same temperature, in the other a softening of mass and heating. The first was thought by Professor Forbes to be a limiting case of the second type; but the author gives reasons for supposing that it is rather an exchange phenomenon analogous to what takes place when water evaporates, and the melting-point is reached when the number of molecules passing from the ice to the water is equal to the number passing from the water to the ice. The sealing wax type is analogous to the change of state in a liquid gas above its critical point, where it changes gradually from a rather liquid to a certainly gaseous state.

MILITARY FIELD TELEGRAPHS.

SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

At the meeting of this society, held on the 26th ult., a paper was read by Mr. P. V. Luke, C.I.E., on the construction and working of a military field telegraph, with especial reference to the recent campaigns in Afghanistan.

Professor FOSTER, who was in the chair, prefaced the paper by reading a letter received from General Roberts, in which he expressed his regret at not being able to accept the invitation of the society for that occasion, especially as he was much indebted to Mr. Luke for the zealous and valuable assistance he had rendered during the military operations in Afghanistan. Mr. Luke's communication to the society was chiefly designed to show what ought to be the arrangements and organisation of a telegraph system intended to follow or accompany an invading army; and the defects of the actual arrangements were brought out by a preliminary description of what took place in the course of constructing and maintaining the line from Peshawur to Kabul during the years 1878, 1879, and 1880. The total length of this line was 500 miles. After the taking of Ali Musjid in November, 1878, the line was laid down to that point, but was immediately disabled by the Affridis, who took away large portions of the wire, though they left the poles, which were merely pulled down. This was a sample of what constantly took place during the whole period, interruptions of this character happening in one instance 98 times in the course of six months. In January, 1879, the line was restored and extended 50 miles further on, where the sappers, working from the opposite direction, met him.

During the Cavagnari campaign the wires were replaced once more and remained working until September 15, when they were cut, and the line wrecked from Kabul, nearly as far as Gundamak. This was immediately following the unsuccessful attack on the cantonments at Sherpur. While the siege was proceeding, strange to say, the telegraph remained working, though thousands of the enemy were near to, and even passing under the wires. After the evacuation of Kabul the wires were coiled up, and there was now, of course, no longer any telegraph to that city.

Turning, then, to the general lessons to be learnt from the experience of this expedition, Mr. Luke referred to Mr. Preece's definition of the three essential elements of a good field telegraph system, namely, the permanent line, the flying line, and visual signalling. In the system of which Mr. Luke had charge, visual signalling was uniformly available for supplementing the service of the wire, and there was, therefore, in a country like Afghanistan, no need for the flying column. The heliograph could always be relied upon for lengths of 40 miles, and at the rate of seven or eight words a minute. In the construction of the telegraph line they had to choose between a heavy line of a permanent kind overhead, a line laid either on or under the ground, or a temporary line on very light poles. They chose the latter, as neither of the other methods were in the least degree safer, or, indeed, hardly so safe. There was no local timber between Peshawur and Dakka; bamboos were therefore made use of, and they lasted very well for periods ranging from six to twelve months. A nick was cut near the upper end, the wire placed in it and bound there. No insulators were needed or used, except in passing precipitous rocks, where insulating arms were driven instead of erecting poles. The bamboos were usually seven or eight feet long, and 20 of these were used for the mile. The wire weighed 300lbs. to the mile, but a wire of 200lbs. to the mile would, Mr. Luke thought, be generally heavy enough—or still lighter for short distances. A camel would carry about four miles, and a mule about two miles of such wire. The general equipments, embracing tools, drums, apparatus, wire, poles and tents were then described, a train of this character being comprised of one officer, one inspector, six trained men, and 44 coolies. The instruments used were sounders, a Siemens with relay, a direct sounder, and a portable sounder. Batteries were the Minotto form of Daniell cells; but these were not always satisfactory. The chief requisites for a battery in field operations were lightness, strength, and quick action. It should also be easily cleaned. Such a battery had yet to be devised. A properly equipped train with its complement of mules will erect from three to four miles a day. The men should be trained in loading and unloading, and in all regular duties, especially where natives are employed. It would be much better if the pioneers were instructed in construction of this kind, as it is often impossible to obtain native labour far from home. The duties of the pioneer corps were similar, and in this respect, as in several other matters, the inference to be drawn from Mr. Luke's remarks was that the military should be always prepared with staff and material for constructing the whole of the telegraph system required on such emergencies. As it was, the civil and the military workers were sometimes found to be doing work twice over. For the more speedy localisation of breakages offices were placed at every ten or twelve miles, called offices of observation, the chief object of which was to try the line up and down periodically in the course of each day, and to send parties out promptly to repair. On one occasion a permanent current connected to alarums was left on so as to give warning of breakage, with the result that a party of marauders were overtaken and punished; but this method interfered with the working of the line, and was not repeated. The paper concluded with some urgent recommendations that the training of the soldiers in telegraphy, which was promoted from necessity during these campaigns, should be kept up permanently in anticipation of any future contingencies. Closer co-operation was also needed between the heliograph corps and the telegraphists.

After some remarks from General MANSELL, who paid a high compliment to the author of the paper for the services he had rendered to the military authorities during these campaigns, Mr. PITMAN described some of his experience with the telegraph train at Candahar. With respect to the non-use of insulators, Afghanistan, it should be noted, is exceptional; and even there it was impossible to work on the few occasions when there was rain or snow. The Candahar wires had been far more fortunate than those under Mr. Luke's charge, a circumstance which he ascribed to the very stern measures which were taken to punish a village whose inhabitants had cut and decamped with the wire. After then only two breakages occurred along the whole line. Mr. Pitman took the opportunity to remark that if we had to go to Candahar again, as probably we should, Herat was within easy reach, and a line would then be easily constructed and maintained to Teheran. This would place our Indian Empire in direct communication with England, and a vast reduction of rates would be admissable. In reference to a question as to whether the civilian telegraphists were under the Mutiny Act when employed on these duties, neither Mr. Pitman nor Mr. Luke was sure about it; but they imagined they were, and in any case they thought they ought to be so. On the other hand, the soldiers ought to be under the same civil laws as regards delaying telegrams; and Mr. Pitman created some amusement by stating that whilst a civilian was punishable for that offence, a soldier could delay any number of telegrams without incurring a penalty more serious than a few hours in the guard room for being drunk on duty.

Colonel WEBBER was glad that the result of this campaign had confirmed his oft-repeated objections to ground wires. Referring to Major Hamilton's experience in Zululand and Natal, he stated that not a scrap of suitable timber for poles was to be had, and that bamboos had not only to be transported but to be imported. For general purposes it would be found that No. 11 wire was the most serviceable for the field.

Major HAMILTON informed the meeting that some recent experiments at Chatham and Aldershot had proved the possibility of working despite of wet weather on moist ground. Using a Tyler sounder and the telephone, a wire was found to work very well carried bare over marsh land. It was then carried through a canal, and still worked satisfactorily. They then cut the wire in the water. The ends sprang back eight or ten feet apart, but the signals were still perfectly readable, though fainter.

Mr. PREECE congratulated military men on adopting the sounder instrument, that being, as he had always told them, the handiest, cheapest, simplest, and most efficient instrument they could possibly obtain.

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After the usual vote of thanks, the PRESIDENT announced the adjournment, until November 10th. In September next, however, it was proposed to hold one or two meetings in Paris during the Exhibition, but due notice would be sent to members as to the exact dates.

THE FUTURE OF THE POSTAL TELEGRAPHS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Your issue of the 28th inst. contains an article on "The Future of the Postal Telegraphs," in which the writer regrets the ignorance of scientific telegraphy among the postal officers in charge of the system, and expresses his misgivings as to the technical training of the manipulative *employés*. His regrets and his misgivings are, alike, only too well founded. Anecdotes illustrative of the ignorance in high quarters are well known to every telegraph clerk. What can we think, for instance, of the surveyor who requested an office to send him their spare clerk when two single wires were replaced by a duplex sounder? And what of a still higher official who thinks it an easy matter to learn sound reading in a fortnight, and who, it is currently reported—though I won't vouch for the truth of the story—once requested the distant station on a Wheatstone circuit to "put more ink in his transmitter," because the received signals were faint.

Under such heads, what amount of technical training can we expect the operators to receive? Just as much as they get from the department, viz., none.

"A desire . . . to understand, and improve, and simplify the means by which the work is done," Mr. Scudamore would have had the operators possess; and beyond all question he was right. But what is the case at present? Simply this, that so far as official recognition or promotion is concerned the study of electrical science, and its application to telegraphy is waste of time to the operator. The most ignorant have as good a prospect as those who have made themselves practical electricians. Only a few weeks since a vacancy at the T.S. test-box was offered to a clerk absolutely ignorant of the elements of electrical science, and this in spite of the fact that there were several clerks in the office well known to the authorities as having studied science as applied to telegraphy. True, the position was finally given to one of these men, but not until it had been offered to, and refused by the clerk first mentioned. Under the present management there is no inducement whatever (in the service of the department) for a telegraph clerk to try to become something more. Consequently ignorance reigns supreme, and it is rare to find a clerk who can intelligently explain the action of a sounder. This state of things can only be altered by a more intelligent and practical superior staff. Let the men who are in charge of the telegraph system be men who have worked their way upward from the ranks, who know the work, who know the apparatus and the staff, and who are scientifically acquainted with their profession. Can such knowledge be fairly expected of men who have been engaged almost all their lives in purely postal work? Let the two services be placed on a level, but their management kept distinct. At present postmasters and surveyors are almost all postal officers, with only the merest smattering of telegraphic knowledge; but they are placed in charge of complicated systems, requiring much experience for their satisfactory working. No telegraph official with an equal ignorance of postal matters would have the slightest chance of obtaining such an appointment. Why should the telegraphs be worse officered than the Post Office? And why should the road of promotion be barred to telegraph officials by thus filling up the best appointments with postal men? If the Telegraph Department is to be conducted in an efficient manner it must be managed by practical men, men who have passed their lives in the work; and it must be made worth the while of the operators to obtain technical and scientific knowledge. At present it is not; naturally they remain ignorant. Much bad working is the daily and hourly result. How can a clerk "balance for duplex" intelligently and efficiently when he or she is utterly ignorant, not simply of the duplex principle, but of the most elementary electrical knowledge? If delicate and refined multiplex or fast-speed apparatus is to work well, it must be worked by intelligent hands. The sooner the postal department realises this the better for itself, and the better for the public. I can promise one thing on behalf of the minority of the staff who do take an intelligent interest in their work and the apparatus with which it is performed, and that is, that if the forthcoming "scheme" does not recognise technical knowledge and ability the operating staff will lose almost all of the little technical knowledge and ability which it does now possess. Between submarine companies, telephone, electric lighting, power supplying, and other companies requiring electrical knowledge, and willing to pay for it, the Post Office will find itself deserted by those whom it does not know how to appreciate.

If the future of the postal telegraphs is to be a good and efficient one, two things must be done. Firstly, the department must be managed by men practically acquainted with the work, and able and willing to test all improvements suggested; and, secondly, the operators must be encouraged in various ways, but chiefly by the opportunity of promotion presented by the first condition, to make themselves thoroughly acquainted with the science of their profession.—Yours, &c.,

A "T. S." OPERATOR.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES JUNE 1.		BUSINESS DONE WEEK ENDING JUNE 1. Highest.	Lowest.
Anglo-American	55¼,	¼	56¼	54¼
Do. Preferred	86,	87	87½	86½
Do. Deferred	27,	¼	28	27½
Brazil Submarine	10¼,	¼	10¾	10½
Cuba	9¼,	¼	—	—
Do. Preference	16¼,	17	—	—
Direct Spanish	3¾,	4¼	4¼	4
Do. Preference	13¼,	14¼	13¾	13¾
Direct United States Cable	10¾,	11	11	10¾
Eastern Telegraph	10¼,	¼	10¾	10½
Do. 6 per Cent. Preference	13,	¼	13	12¾
Do. 5 per Cent. Debentures, 1899	106,	109	107¾	107
Eastern Extension	11¼,	¼	11¾	11¼
German Union	11¼,	12	11¾	11¼
Globe Telegraph and Trust Company	6¼,	¼	6¼	6 5-16
Do. Preference	12¾,	¼	12¾	12¾
Great Northern	13,	¼	13	13
Indo-European	28,	29	—	—
Mediterranean Extension	2¼,	¼	2¼	2¼
Do. Preference	9¼,	10¼	—	—
Reuter's	11,	12	—	—
Submarine	270,	290	—	—
West India and Panama	2¼,	¼	2¼	2 5-16
Do. 1st Preference	7¼,	8	7¼	7 5-16
Western Brazilian	8¼,	¼	8 7-16	8¼
West. Union 7 per Cent. 1st Mortgage	120,	125	—	—
Do. 6 per Cent. Sterling Bonds	106,	110	108¼	108¼

TRAFFIC RECEIPTS FOR MAY, 1881.

COMPANIES.	May, 1881.	May, 1880.	Increase.	Decrease
Anglo-American Telegraph Company	£49,880	41,970	7,910	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	3,000	2,972	28	—
Direct Spanish Telegraph Company	—	—	—	—
Direct United States Telegraph Company	16,630	13,990	2,640	—
Eastern Telegraph Company	43,872	42,963	909	—
Eastern Extension Telegraph Company	29,523	26,570	2,953	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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Prevention of the Breaking of Fibres in Wearing from their being Electrified. By E. B. BRIGHT.
Telegraphs in Japan. By J. MORRIS.
Application of Electricity to Domestic Lighting and Heating. By Sr. G. LANE FOX PITT.
Electric Light Current Galvanometer. By Professors AYRTON and PERRY.
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RECENT INVENTIONS.

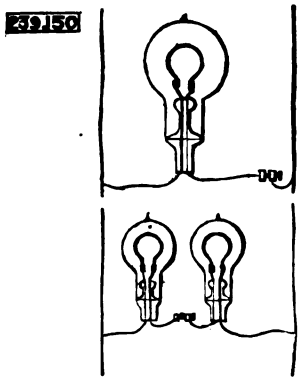
ABSTRACTS OF SPECIFICATIONS.

4192. IMPROVEMENTS IN THE METHOD OF AND LAMPS FOR USING THE ELECTRIC LIGHT ON LOCOMOTIVE ENGINES, *G. P. Harding.* —*Dated 15th October*, 1880. 4*d*.

The inventor places the lamp on the fore part of the chimney, and uses reflectors to throw the light forward. He places his generator upon bearings attached to the framework of either the engine or tender, and connects its driving pulley by a pulley, which, by means of gearing keyed or connected with the axles of the engine or tender, will drive the generator at a suitable speed; or he attaches to the engine or tender a small auxiliary engine, so that when the locomotive is stationary the light may still be kept going. The object is to light the track for a long distance ahead.

239,150. ELECTRIC LAMP, *Thomas A. Edison, Menlo Park, N.J.—Filed August 6th*, 1880.

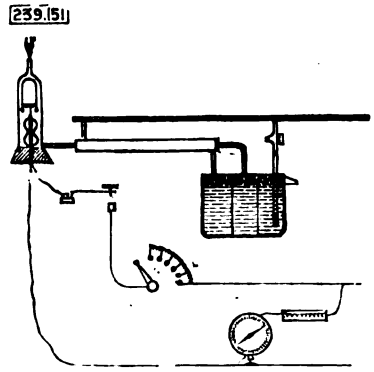
Claim.—(1). The combination, with one derived circuit, of a multiple arc system of two or more lamps, each of a frictional resistance and radiating surface of the resistance, and radiating surface of the standard lamp of the system,



the fraction being the number used, substantially as set forth. (2). The combination, with one socket or holder and one derived circuit, of one circuit controller and two or more lamps, each of a fractional resistance and radiating surface of a standard lamp, substantially as set forth.

239,151. METHOD OF FORMING ENLARGED ENDS ON CARBON FILAMENTS, *Thomas A. Edison, Menlo Park, N.J.—Filed November 24th*, 1880.

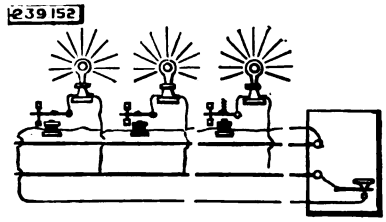
Brief.—Heats by incandescence only the ends of the filaments in a hydrocarbon vapour. *Claim.* —(1). The method herein described of forming enlarged ends upon carbon conductors, consisting in forming an electrical circuit only through the portion desired to be enlarged, thereby heating the same in a vessel, through which flows a stream of vapour from a carbon compound, substantially as set forth. (2). The combination of a receiving globe or chamber, means for passing therethrough a stream of vapour from a carbon compound, and means for forming an electrical circuit through any desired portion or portions of



a carbon conductor within said globe or chamber, substantially as set forth.

239,152. SYSTEM of ELECTRIC LIGHTING, *Thomas A. Edison, Menlo Park, N.J.—Filed October 30th*, 1880.

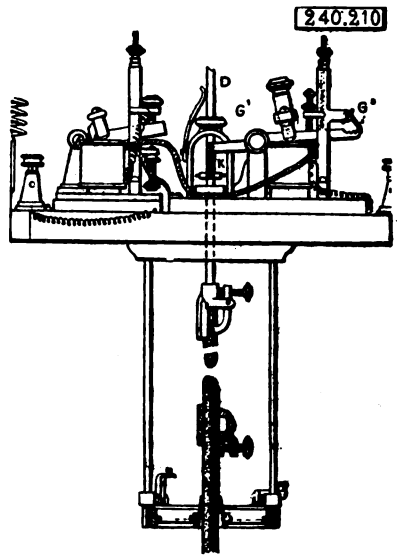
Claim.—The combination, with a main circuit and branch or multiple arc circuits, and translating devices in the latter, of a controlling circuit and devices therein controlling or governing the



circuits through the translating devices, and means in the controlling circuit for causing, at will, the controlling or governing devices therein to operate, substantially as set forth.

240,210. ELECTRIC LAMP, *Edward Weston, Newark, N.J.—Filed July 8th*, 1879.

Claim.—(1) An electro-magnet and an armature the opposed parts of which are respectively in the form of a cone and of a hollow cylinder, the armature having a range of motion permitting the cone to enter the hollow cylinder when the armature yields to the attraction of the magnet, substantially as and for the purpose described. (2) An electro-magnet having a longitudinally hollow core, in combination with a conically-pointed movable armature having a range of motion permitting its conical point to enter the tubular pole of the magnet, substantially as and for the purpose described. (3) In combination with an electro-magnet provided with a hollow core and a conically-pointed movable armature, an adjusting device, by means of which the range of movement of the lever to which the armature is attached may be adjusted, substantially as described. (4) In an electric lamp, the combination of a main circuit of small resistance, which includes the carbons and the principal coil surrounding the electro-magnet, with a derived circuit of large resistance, which includes a coil wound differentially upon the electro-magnet, and a circuit closer adapted to close the derived circuit whenever the resistance in the main circuit is increased to a prescribed amount by the too great separation of the carbons, substantially as and for the purpose set forth. (5) In an electric lamp the combination of the carbons with a differential magnet, the two oppositely wound coils of which are respectively included in the main circuit, which includes the carbons, and in a derived circuit whereby the distribution of the current in the two circuits is automatically dependent upon the progress of the combustion of the carbons, substantially as described. (6) In an electric lamp, in which the force of gravity tends to diminish the distance between the points of the carbons, a lever to which at one end a movable carbon is suspended, and upon which at the other end an armature is affixed, in combination with an electro-magnet, the opposed parts of the armature and magnet being respectively conical and tubular, whereby the armature has a prescribed range of movement in the magnetic field, during the whole of which there is no material variation



in the amount of attractive force exerted upon it by the magnet, substantially as and for the purpose set forth. (7) The clamp K, composed of the pivotted clamping jaws, respectively linked to the forked end of the rocking armature lever, in combination with the vertical sliding rod D, as and for the purpose set forth. (8) The clamp K, composed of the pivotted jaws, the armature lever, and links connecting the same, in combination with a stop adapted to disengage the jaws from the movable carbon-holder when the same has been dropped to the desired point. (9) The combination, in an electric lamp, of the vertical sliding carbon-holder D, the clamp K, the forked armature lever G, to which the clamp is linked, and an electro-magnet, the coils of which are included in the circuit which supplies the lamp, substantially as described. (10) The armature lever G and the upper carbon-holder and clamp in combination with the pawl G^3 for holding up the end of the lever carrying the clamp, substantially as set forth.

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SLIP

ANOTHER ELECTRICAL RAILWAY.—An electrical railway is in process of construction at the Italian National Industrial Exhibition now proceeding at Milan.

DESTRUCTION OF TELEGRAPH LINES IN IRELAND.—The wires at Skibbereen, co. Cork, have been cut, and are lying about the roads so as to impede the traffic.

ELECTRIC RAILROADS.—Experiments are being made with a view to running trains through the St. Gothard tunnel by electricity, with motive power obtained from the Reuss and the Tessin.

ELECTRIC LIGHT IN MINES.—We understand that experiments under the orders of the Accidents and Mines Commission are being carried out at Pleasley Colliery, near Mansfield, with the Swan incandescent lamp.

ASSASSINATION IN ALGERIA.—Intelligence from Oran, dated the 5th of June, says that M. Bringard, Inspector of Telegraphs, has been assassinated, with his escort, between Frandah and Geryville. Eight men were killed.

MELBOURNE EXHIBITION.—Messrs. Marshall, Sons, and Co., engineers of Gainsborough, have obtained the highest award at the Melbourne International Exhibition for their portable, vertical, and horizontal stationary engines, which are specially adapted for driving electric light machinery.

"SOCIETY OF TELEGRAPH ENGINEERS' JORUNAL."—We understand that the abstracts in the *Journal* are generally arranged so as to treat more or less on one and the same subject, and that the abstracts in the current number relating to the contact theory were intentionally and not accidentally arranged.

PRICES.—The prices as quoted this week are:—For gutta percha, genuine, 4d. to 3s. 3d. per lb.; reboiled 3d. to 1s. 3d. For india rubber, per lb., fine Para 3s. 7d., negrohead 2s. 4d., central American 1s. 11d. to 2s. 6d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

PRIZE OFFERED.—The Jablonowski Society of Leipzig offer a prize of 700 marks (a mark = 1 shilling) to be given in 1883 for the determination of the photo-electrical tensions produced in artificial and suitably coloured crystals by the action of light, and their relations to the thermo-electrical effects produced by changes of temperature.

INSTITUTION OF CIVIL ENGINEERS.—The annual conversazione of this institution was held at South Kensington last week. The rooms were pleasantly illuminated by the electric light. The night being a hot one, offered a good opportunity for showing off the advantages offered by the electric light as a non-heater of the atmosphere, at all events to any appreciable extent.

THUNDERSTORMS.—On Monday severe thunderstorms occurred all over England, great damage being done by lightning in many places. At Margate the lightning struck the conductor of St. John's Church, the fabric, however, being uninjured. A house at Badnesley Ensor, near Atherstone, was also struck by lightning, and a man and a child narrowly escaped death.

ELECTRIC LIGHT IN DUBLIN.—The offer of the Alliance and Dublin Consumers' Gas Company to light some of the streets of that city by the electric light at their own cost has been rejected by the Corporation, mainly, we believe, because applications have been received from the Brush and Swan Companies for permission to light the streets experimentally for a short time.

RUSSIA.—News from St. Petersburg says that a dynamite mine has been discovered under the railway metals close to Gatschina Station. The mine was connected by wire with an electric battery in the railway telegraph office. All the telegraph officials have been arrested.—The obelisk erected in Gatschina Park by Paul I. has been destroyed by a flash of lightning. A sentinel stationed at the foot of the obelisk was killed.

POST OFFICE TELEGRAPHS.—We are glad to be able to announce that upon the recommendation of the Postmaster-General, the Lords Commissioners of Her Majesty's Treasury have sanctioned the payment of a gratuity of £20 to Mr Barnett, a telegraphist at Aldershot, who has devised an ingenious arrangement whereby an ordinary single-needle instrument can be converted into an acoustic instrument at a small cost.

THE ELECTRIC RAILWAY AT BERLIN.—The Electric Railway between the Lichterfeld Station and the Central Cadet Institution has been so successful that the authorities have given permission for its extension, first to Tetlow, and subsequently to Potsdam. At road crossings the conductors of the electric current are in future to be laid under the ground, so that horses may not be exposed to a shock. This has been found to be necessary, as horses have fallen while crossing the rails, or been terrified into running away by the shock.

COMPLETION OF THE SCOTCH CABLES.—The Morna, having on board Commander Howling, R.N., and a staff of electricians, &c., arrived at Greenock on Friday week in charge of Captain A. Campbell, after having completed the laying and repairing of telegraph cables at Stornoway, Islay, and Lochfyne. Whilst off Inverary, a foreman, engaged superintending the laying of the cables, named Benjamin Cook, was seized with apoplexy, and died in a few hours. He resided in Woolwich, and leaves a widow and family. The body was forwarded to Woolwich.

FEMALE TELEGRAPHISTS IN VICTORIA.—The experiment of employing female telegraphists in Victoria has not been entirely successful. The Deputy Postmaster-General of the Colony reports that they are not equal to any continuous strain, and that five young men are found to be fully equivalent to ten young women. We have heard before this that the women of the Australasian Colonies will by no means compare with those of our own islands in point of "go" and vitality. We suppose that the enervating effects of the temperature they have to submit to is the cause of this limpness in our faraway cousins.

UNDERGROUND WIRES.—At a recent meeting of the Town Council of Stafford, on the proposition of the Works and Waterworks Committee to sanction the laying down of pipes for telegraph wires by the Postal Telegraph Department, the mayor proposed an amendment that the matter be deferred for further consideration. He observed that the Council had been treated in a very defiant manner, inasmuch as the work had been commenced before any sanction had been obtained. The amendment was carried unanimously. It was also resolved that notice be sent to the contractor for the work and the engineer of the Telegraph Department.

THE NEW ATLANTIC CABLE.—The ss. "Faraday" is stated to have left Penzance for Whitesand Bay, Land's End, on Monday morning last, but was obliged to return owing to the weather being too rough to admit of the shore end of the new Atlantic cable being landed. Later news says:—The "Faraday," in command of Captain Maypee, left

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Mount's Bay (Cornwall) for Whitesand Bay at 5 o'clock on Wednesday evening to lay the shore end of the new Atlantic cable, the weather having moderated. By a quarter-past 10 the end was successfully landed. The "Faraday" has left for London to take in the remainder of the cable.

A Boat Propelled by Electricity.—M. Trouvé having succeeded with his tricycle on land has now turned his attention to the propulsion of boats by electricity. He recently made an experiment in a small pleasure boat in Paris, measuring 5·50m. by 1·30m., in which were three persons. He used a magneto electric motor weighing 2 kilogrammes, and two series of six Wollaston cells weighing 12 kilogrammes each. With these he obtained a speed of 1·30m. per second. The motor was placed on the rudder, the motion being communicated to a small screw placed in the lower part of the boat by a chain. He intends extending his experiments on the lakes of the Bois de Boulogne.

The Telephone in Egypt.—There are two companies at work erecting telephone lines, the Compagnie Téléphonique, represented by M. Edwin de Léon, which has been established some little time, and the more recent Messrs. Hubidos, Dargon, and Company. The latter offer to erect telephones at the undermentioned charges: 875 francs per annum for consuls, bankers, &c.; 750 francs for stock-brokers and large firms; 650 francs for merchants and members of the liberal professions. The above subscriptions to be payable in advance. The Company will erect and keep in order the necessary apparatus, &c., as soon as sixty or more subscriptions have been received.

A Novel Fault.—*La Lumière Electrique* says that during the campaign in Algeria a telephone was installed between the telegraph stations of Souk-el-Arba and Medjez-el-Bab. Whilst the telegraph instrument was at work a fault suddenly developed, and communication ceased. Thinking that this was due to the natives, a line man was sent out, escorted by cavalry, to rectify any damage that might have been done. The party, however, found, to their great surprise, that a large snake had coiled itself round a post and the wires, and thus interfered with the conductivity of the line. During this novel interruption communication was able to be maintained by means of the telephone circuit.

Fire Balls.—Under this heading a correspondent in *Nature*, of the 2nd June, writes as follows:—"I was standing in a window on the second floor of the Hôtel Braganza, in Lisbon, which stands close to and high above the Tagus, and had an unbroken view of the river. There occurred a flash (of lightning), followed by an instantaneous crash; but the tail of the flash, however, gave origin to two balls, which descended separately and not far apart, towards the river, and when quite close to, or in contact with the water, burst in rapid sequence, with explosions which might have been the crack of doom." The correspondent in question does not give the date of the occurrence, but says it was some years ago.

Faure's Battery.—Speaking of this means of storing electricity, the *Gas Journal* says:—"We know what the electrical and magnetic power companies are doing, and should these even succeed in widely extending their business, the profit to be gained by the use of storage batteries would still have to be proved. It is known that gas can be supplied through pipes with perfect success, as electric energy can be transmitted through continuous conductors; but the Portable Gaslight Company found that they could not send out gas in carts and make a good return, and the same fate would certainly overtake an undertaking to distribute bottled magnetism while the regular article in bulk is not yet established in the market."

Submarine Cable Extensions.—The *Colonies and India* says: "Lord F. Cavendish made use the other evening of a strong argument—unintentionally it would seem—in favour of submarine telegraph cable extensions. He said in effect that the new cable to South Africa, *viâ* Aden and Zanzibar, had given such great additional facilities for trade and exploration that it was considered unnecessary to continue the subsidy to the British India Steamship Company. The value of the South African cable, from a political and national point of view, must surely be equally apparent to the Government; and, in view of this, will not the Government look with a favourable eye on the proposed cable from Bermuda to Halifax?"

Joel's Lamp in London.—An exhibition of the Joel electric lamp was recently given at the offices of the Prudential Assurance Company, Holborn-bars. Nine lamps of 150 candle-power each were erected by Rowatt and Fyfe's Electric Light Company in one half of the upper floors; the other half being lighted with 45 ordinary gas lights, to compare the two systems. The lamps were fed by a B Gramme machine, driven by a steam engine of 20 horse-power, the estimated horse-power employed during the exhibition was, however, only $3\frac{1}{2}$, the Gramme machine making 800 revolutions per minute. The light gave satisfactory results, keeping the atmosphere cool, whilst the amount of light given out was far larger than that from the gas burners.

Gas v. Electricity.—The accident which recently placed a large town in the United States in darkness through the extinction of the gas is of a kind which, it must be admitted, is of very rare occurrence; whereas the enemies of the electric light can point to many such accidents already in connection with that system of illumination. But how different the consequences! The breakage of a wire means, at worst, temporary darkness; the temporary stoppage of a gas main at night-time means either escape of gas at thousands of places where no hands are near to guard against probable explosion, or else complete withdrawal of the supply for the whole night. If the electric light occasionally fails, it can, at least, recover without the risk of blowing up half the town.

The Electrical Tramway in Paris.—Messrs. Siemens and Halske have commenced operations for the construction of the electrical tramway in the Champs Elysées. The line will differ from the electrical railway in that the current, instead of traversing the rails, is conducted along an overhead cable placed above the carriage, with which it is in connection. People will thus be able to walk across the rails with impunity—a thing they could not do in the case of the railway, where the current traverses the rails. The departure terminus will be situated in the Champs Elysées, near the Chevaux de Marly, and the line will extend to the interior of the Palais de l'Industrie. There will be but one set of rails. The car will be constructed on the same model as those of the Tramways Nord. The cost of a ticket for the whole journey will be 25 centimes.

The Paris Electrical Exhibition.—*L'Electricité* says that the Compagnie du Chemin de Fer du Prince Rodolphe, which we suppose to be an Austrian Company, have built a locomotive with an electric head light, and that they will exhibit the engine at the Exhibition. The light will illuminate the track for 500 metres, if straight. The Université de Greiswalt will also exhibit a monster electro-magnet. The same journal says that the total weight of the iron employed in its manufacture is 628 kilos., of wire 223 kilos., and 423 kilos.

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of copper; or ten times as much iron and thirteen times as much copper as was used in Faraday's magnet, and nine times as much iron and nine times as much copper as was used in the Plucker magnet. The distance between the poles is double that in Plucker's, and nearly six times that in Faraday's magnet.

RADIOPHONY.—At a recent meeting of the Academy of Sciences at Paris, M. Mercadier read a paper in continuance of his researches on radiophony. Amongst other experiments described by him was one in which light was reflected from a plate of silvered glass, behind which was a small reservoir of air, with a thin plate of mica and tube to receive the voice. The receiver was formed of one of M. Mercadier's small glass tubes, with a piece of smoked mica in it and a hearing tube. The light is concentrated, in the usual way, on this receiver by a lens. With this arrangement speech was distinctly heard at a distance of 20 m. The investigator found, amongst other things, that when an alum solution was interposed, the effects were much diminished. With a thin plate of ebonite they were, though weaker, yet distinct, the same holding good with thin plates of zinc, tinsel, copper, &c.

CAUTION: WATER CISTERNS.—Our attention has been called to a curious, though probably not exceptional risk, incurred in using copper balls for the taps supplying metal water tanks. A case has just occurred at a public building, where the whole surface of the stored water became rapidly coated with green crystals, and the copper ball was eaten into holes. The plumber's explanation, after repeatedly cleansing the tank and providing fresh balls, was that sulphate of copper was maliciously thrown into the tank! Examination by persons who were *not* plumbers disclosed the fact that the elbow of the ball-tap was affixed to the margin of the tank, so that a perfect galvanic couple was in constant action. If the tank in question had supplied drinking water, which fortunately it did not, the consequences might have been serious. But it is highly probable that this homicidal arrangement is by no means uncommon, and we advise the public to look to their cisterns.

ELECTRIC LIGHT ON THE EMBANKMENT.—At the last meeting of the Metropolitan Board of Works, the following report was received with reference to the lighting of the Embankment by electricity:—"The Works and General Purposes Committee reported that they had had under consideration a letter from the Société Générale d'Electricité, proposing that from July the rate of lighting on the Embankment should be reduced from $2\frac{1}{4}$ to $1\frac{1}{2}$d. per light per hour; that the number of lights should be increased from 50 to 80, or at least 70; that the hours of lighting should be from sunset to sunrise; and that the contract on these new terms should be for at least five years. The price now paid by the Board was $2\frac{1}{2}$d. per light per hour (inclusive), and the number of lights now in use was 50, of which 40 were on the Embankment, and 10 on Waterloo-bridge. From a calculation of the Board's consulting chemist, it appeared that the cost of the electric lighting would be about £3 2s. per day, while that of the gas lamps was about £3 per day. The amount of light furnished by the electric lights was in the ratio of 4·8 to 1. The committee considered that the period proposed for the continued lighting was too long, and should be limited to three years, and, subject to this alteration, they recommended that the terms offered by the society should be accepted." This was agreed to.

THE PRINCIPLE OF THE CONSERVATION OF ELECTRICITY.—The following is an abstract of a note recently presented by M. G. Lippmann on the above subject to the French Academy of Sciences, alluded to by Professor S. P. Thomson in his letter published in our issue of 28th May. M. Lippmann said that in any electrical phenomenon it would be seen that the distribution of the electricity may change, but that the sum of the quantities of free electricity never varies. If the electric charge experiences a positive variation at certain points, it experiences at other points a negative variation; and the algebraic sum of all the simultaneous variations of the charge is always zero. This law I call the principle of the conservation of electricity. Let us call x and y two independent variables, upon which the quantity of electricity which a body receives depends; x may be, for example, the potential which a body acquires, and y its capacity or anything of which the capacity is a function, a length, a pressure, a temperature, &c. Let dm be the quantity of electricity received by the body, while x increases by dx, and y by dy. We may, without assuming any other conditions, write:

$$dm = P\,dx + Q\,dy,$$

P and Q being two functions of x and y. The principle of the conservation of electricity is expressed by the condition that dm be an exact differential. Suppose we divide any system in which an electric phenomenon is occurring into two parts A and B. Let a and b be the variations of charge experienced simultaneously by these two portions; by virtue of our principle we have $a + b = 0$. In the case in which A passes through a complete cycle of changes, so that its final state is identical with its initial state, we shall have $a = 0$, and therefore $b = 0$. This last equation may be written $\int dm = 0$. Now, that an integral such as $\int dm$ may be zero for a complete cycle, we know that it is necessary and sufficient that dm be an exact differential, which is again implied by the condition of integrability that

$$\frac{dP}{dy} = \frac{dQ}{dx}$$

Such is the general analytical expression of the above principle.

UNDERGROUND WIRES IN GERMANY.—The Consul-General for Frankfort-on-Main reports as follows on the underground system in Germany:—The cables employed are manufactured partly in Germany and partly in England. The principal contractors (Felton and Guilleaume, of Cologne) obtain the raw cable from England, and finish the same by enveloping it in a cordage covering at their extensive establishment at Mülheim-on-the Rhine. The Berlin contractors — Messrs. Siemens and Halske —formerly obtained their cables also from England, but they now manufacture them at their own establishment. The experience had in Germany resulted in the adoption substantially of the conclusions of a scientific commission appointed to investigate the subject as to the manner of constructing the cables. This commission recommended that each conductor consist of seven copper wires, each six-tenths of a millimetre in diameter, twisted into one cord. The cable should contain seven such conductors, insulated by double layers of gutta percha, and enveloped in two layers of Chatterton compound, the first layer of the compound being next to and enveloping the wires, and the second intervening between the two layers of gutta percha. The thickness of the single insulated conductors was fixed at 5 millimetres, and the thickness of the coverings of tarred hemp at 17 millimetres. The protective envelope of the cable was to consist of 16 galvanised-iron wires, each 4 millimetres in diameter, forming together a complete encompassment of the cable at each 25 or 26 centimetres of its

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extension, and fitting it firmly. Outside of all the cable should be coated with inspissated coal-tar free from creosote, and should receive a covering of the same substance after being laid in the trench. The single cable-cords were to be made in sections of 800 metres, but as now supplied and used they have a length of 1,000 metres. About 5,240 kilometres of cable and 35,830 kilometres of wires are now laid in this manner.

New Galvanometer for Powerful Currents.—The following appeared in Silliman's *American Journal*, from the pen of Professor C. F. Brackett, College of New Jersey, and was reproduced by the *Phil. Mag.* for June:—The very powerful currents produced by large dynamo-machines are not easily estimated by the appliances usually found in the physical laboratory. The various forms of the electro-dynamometer, the cosine-galvanometer, and some other special forms of apparatus may, of course, be employed with satisfactory results. None of these instruments being in the collection at Princeton, it was determined to construct a galvanometer which should obey the law of tangents, and yet not be so large as to be unwieldly. In order to do this recourse was had to the differential principle. The construction is as follows:—Two stout hoops of copper or brass of different diameters are very exactly turned in the lathe. They are then each cut open at one point and joined to each other concentrically, by soldering with hard solder, between the ends on one side of the cut, a piece of metal having the same cross section as that of the hoops, and of suitable length. At several other points are inserted between the hoops pieces of hard rubber of proper thickness, which serve to keep them truly concentric. The free ends of the system thus arranged, and set upright on a proper base-board, are joined to binding-screws. It will be seen that the differential action on a needle placed at the centre, or on the axis of the hoops passing through their centre, depends on the different distances of two equal and opposite currents. It is evident also that the instrument may be used as a simple tangent-galvanometer. Thus, if we call the free ends of the hoops A and B respectively, and the point of juncture C, by joining up a circuit through A and B we get the differential action; but by joining up through C and A or B, the action is that of a simple tangent-galvanometer. If r and r' represent the radii of the outer and inner hoops respectively, the ordinary formula becomes

$$I = \frac{rr'}{2\pi(r-r')} \times H \tan d$$

when the instrument is used differentially. An instrument has been constructed at the J. C. Green School of Science for its physical laboratory, of dimensions as follow:—

Diameter of outer hoop	10·9 centim.
Diameter of inner hoop	9·96 „
Width of each hoop.....	2·3 „
Thickness of each hoop	0·35 „

The theoretical constant of this instrument agrees very closely with that ascertained experimentally by means of the voltameter. The needle, which is usually suspended in the centre of the hoops, may, if desired, in order to measure exceedingly powerful currents, be moved along their axis to any required distance on one side. The constant is in that case easily found by an obvious modification of the formula.

Internal Discharges of Electrical Condensers.—The *Phil. Mag.* reproduces an article by E. Villari, published in the *Atti dell' Acc. della Soc. di Bologna*, 11th Nov., 1880, ser. 4, vol. ii., 1881. He says:—"When a strongly charged battery is discharged a characteristic rumbling noise is produced in its interior, the glass of the jars becomes brightly luminous at the edges of the coatings, and heat is evolved, as I have ascertained by introducing one of the jars into an air-thermometer suitably arranged. Therefore, besides the *ordinary* external discharge of the jar there is another in its interior, which I will call *internal*, to distinguish it from the former. It takes place along the sides of the condenser where they are destitute of coating, and it is appreciable by the light and heat which accompany it. On measuring the internal discharge by the thermometric dilatations which it produces we arrive at the following conclusions:—1. The heat evolved by the internal discharge can be neglected with feeble discharges; beyond certain limits, however, it manifests itself, and increases very rapidly with the discharges themselves; thus a principal means for augmenting this internal heat is to employ jars to a very high potential. 2. The internal discharge increases sensibly if the internal spark is produced between two balls from 10 to 30 millim. in diameter; it is diminished, on the contrary, by almost one half if the spark is called forth between a point and one of the balls. It is the reverse for the heat produced by the external exciting spark. 3. The internal discharge increases, for a given charge, if the internal coating of the jar be diminished; it diminishes if we augment the coating until it meets the outer coating. From this point it remains almost independent of the extent of the coating within the limits in which I have operated. The reason of these phenomena is complex; they depend in part on the variation undergone by the potential of the discharge with the extension of the coating, and partly on the influence exercised by the different extents of the two coatings upon the number and size of the sparks. 4. The internal discharge is the same with an ordinary as with a spark-discharging jar. 5. The internal discharge falls to zero when the resistance of the external circuit is much increased. 6. The internal discharge appears, *cæteris paribus*, a little stronger with an internal coating of mercury. With this exception the jar behaves like an ordinary phial with a coating of tinfoil. The foregoing conclusions, deduced from the thermometric dilatations, are completely confirmed by the luminous phenomena exhibited in the jars, since the brightness and size of the internal sparks constantly correspond almost exactly with the extent of the thermometric dilatations. 7. The internal discharges depend, in my opinion on this—that each coating induces or excites in the insulating slip a zone charged with opposite electricity to its own, the zones induced by the two coatings being separated by another zone of glass in the natural state. At the moment of the discharge a part of the electricity of the coating and of the electrified zone neutralise each other with production of sparks and heat; hence the internal discharge. 8. The existence of these electrified zones can be demonstrated by the electric figures obtained on projecting upon a Franklin square of varnished glass, or, better, of ebonite, or on a charged Leyden jar, the well-known mixture of sulphur and minium. After the discharge of the condensers those figures can no longer be distinguished; for the electric zones, more or less, completely destroy one another at the very instant. 9. When the Franklin square has its coatings unequal, the neutral zone on the side of the smaller coating, as well as the electrified zone, increases in extent at the moment of the discharge, at least in certain cases. 10. In studying by this method some squares of glass with unequal coatings, or, better, of ebonite, with coatings unequal or equal, I have observed that after they had been discharged as usual the coatings were found to be charged with the opposite electricity to that which they had originally."

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LITERATURE.

Electric Lighting by Incandescence and its Application to Interior Illumination: A Practical Treatise, with ninety-six Illustrations. By W. E. SAWYER. New York: D. Van Nostrand. London: E. and F. N. Spon.

We quite agree with the author, who in his first sentence says, "The subject of electric lighting by incandescence is one of general interest." Its interest is so general that if it can be experimentally proved that the incandescent light is at all comparable in cost with gas, that it can be managed without trained labour, that there is no danger attached to its use, and that it can be regulated and the energy consumed measured as easily as we measure the gas that passes through the meter, then it will be *the* light of the immediate future. Mr. Sawyer, who has been working for a long time in this experimental field, has compiled a number of facts, and put them forward for use in the work before us. He deals with his subject in twelve chapters, discussing respectively:—1. Generators of Electricity. 2. Generators of the Gramme Type. 3. Of the Siemens Type. 4. Incandescent Lamps. 5. Carbons. 6 and 7. New Forms of Lamp. 8. Preservation of Incandescent Carbons. 9. Division of Current and Light. 10. Regulators and Switches. 11. General Distribution. And 12. Commercial Aspects.

It is impossible to write upon incandescent light without referring to the arc light, and of this Mr. Sawyer says:—"The voltaic arc is the most economical of electric lights, and in the illumination of large open spaces and for all purposes requiring much penetrative power, it will doubtless maintain its supremacy. In many cases of experimental test it has developed a light of from 1,000 to 2,000 candles per horse-power of force expended in driving the generator, the cost of which in large steam-engines is less than one cent. per hour."

Speaking of generators, our author says:—"The value of a pound of coal in mechanical energy is about 12,000,000 foot-pounds; the value of a pound of zinc is about 1,845,000 foot-pounds. The cost of a pound of zinc is about twenty-five times the cost of a pound of coal. With this great discrepancy between the energy and cost of the one and the energy and cost of the other, and after making due allowance for all the facts favourable to zinc, it is clear that in electric lighting at least the period of usefulness of the galvanic battery has passed not to return." The Wilde machine is said to contain "the germ of a perfect generator," but the statement may raise discussion that "where a single lamp or a limited number of lamps is to be operated, it does not appear advisable to employ an exciting machine, the practical use of the latter being in the lighting of buildings or sections of a city requiring a large number of lamps and a common source of supply." The various machines before the public are described, such for example as the Wilde, De Meritens, Lontin, Siemens, Gramme, Maxim, Brush, &c., the descriptions of the different methods of winding being especially good. Among the older forms of incandescent lamps described we notice Renier's, Werdermann's, Starr-Kings's, Koun's, and those of Bouliguine, Fontaine, and Farmer, the descriptions of the newer forms being more elaborate. These latter include the lamps of Edison, Maxim, Sawyer-Mann, Sawyer, &c. The chapter on the "Preservation of Incandescent Carbons" discusses the methods used, such as filling the globe with a non-combustible gas, exhausting to a high degree, &c., and an interesting series of diagrams is given showing the behaviour of carbon under varying conditions. In one of the figures is shown an example of the intensity of the heat of an incandescent carbon. "Owing," says the author, "to disintegration of the upper point of contact, one of the short Sawyer-Mann pencils, losing its support while at limpid incandescence, was projected against the side of the globe, through which it instantly passed as though the glass, which was one-twelfth of an inch in thickness, had been so much tissue paper, fusing its way slightly downward, and finally settling in the position shown, sealed in the glass as perfectly as a platinum wire is sealed in a Geissler tube." The question next under consideration is the division of current and light, and here again we shall allow the author to speak for himself, and then our readers will be able at once to gain a fair idea of his matter and style. He says, "Much has been written concerning the loss of light by subdivision of the current, and this has been variously estimated, sometimes as the square and sometimes as the cube of the number of lights among which the current is divided. Upon what data, and with what purpose these estimates have been made it is difficult to conceive, for they have no foundation in practical fact. If to the conducting pipe of a gas system a given volume of illuminating gas is supplied in a given time, and all this gas is consumed in a single burner in order to yield a given light, when we divide the volume of gas thus supplied among two or more burners the total light produced may, indeed, have greatly decreased. We do not, however, supply gas in this manner, but the volume of gas supplied is in direct proportion to the number of burners to be fed. What is true of gas is equally true of electricity. If a fixed volume of current sufficient for one light is furnished to a single lamp the maximum effect is produced, and if we divide this fixed volume among two or more lamps the total effect is greatly diminished; but to suppose that such a division is contemplated is to suppose a similar operation in the case of gas, and criticism of statements based upon such a supposition is simply waste of time and labour. When we increase the number of lights in circuit we increase the volume of current in proportion, and the power of the total light is increased in proportion, and the energy expended in producing the light, and, therefore, its cost, is increased in proportion. Without at this time entering into any considerations of the fact that the current from a single generator of electricity has repeatedly been divided between from two to two hundred incandescent burners, the operations of the Brush system of voltaic arc lighting set at rest the question of economical subdivision. Two machines of the Brush type are selected for comparison, viz., the six-light and the 16-light machines, both of which are in practical use throughout the United States—the light of each of the twenty-two lamps being of the same intensity as that of each and every other lamp. With the six-light machine the total driving power absorbed is 618,090 foot pounds, or 38,630 foot pounds per lamp. It is thus clearly shown that for each lamp added to the circuit there is an expenditure of power in proportion to the additional work, the somewhat diminished power per lamp expended in the sixteen light machine being mainly due to the element of friction, in which the per centage of absorption of power is less in large than in small generators. As a matter of fact, there is no limit to the divisibility of the electric current. While the possibility and the impossibility of its divisibility become from time to time the subject of controversial discussion, practical subdivision is a daily concomitant of every telegraphic circuit. Even in telephonic transmission the current generated is divided between the transmitter and the receiving instrument, and in some large telegraphic stations the wires radiate from a single generator in several directions, and in the circuit of each of these wires, at towns and cities along their route, there is placed a greater or less number of instruments, each of which is energised from the source common to all of them; and the proportion of current supplied to each instrument is made substantially the same in all cases by making the resistance of the instruments uniform. The strength of the current thus supplied is, of course, inadequate to the operation of an electric-lighting system, as an ordinary main line telegraphic battery is inadequate to the operation of even a single voltaic arc lamp; but if we increase its strength proportionately, and for each telegraphic instrument substitute an electric lamp, we as certainly accomplish subdivision of the electric light current as subdivision of less powerful currents is accomplished with telegraphic instruments. Indeed, the laws which govern the supply of gas to gas burners, and the supply of electricity to electric burners, are daily recognised, and availed of in the operation of telegraphic circuits. For instance, in operating a given number of telegraphic instruments in series, we

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employ a given number of cells of battery. Suppose, now, that we double the number of instruments and the resistance of the circuit, all the instruments, since they receive proportionately less current, become practically inoperative, and we increase the number of cells, and therefore the electromotive force of the battery, in proportion to the additional work required, which is that of overcoming the added resistance. If, on the other hand, we divide the current from a single generator among two or more lines, each including a number of instruments in series, we require a current of greater quantity; hence we increase the size of the elements of the generator. In electric lighting there are five methods of dividing the current from a single generator of electricity.

1. The Series System. Passing the current seriatim through the lamps, as in the Brush system of lighting.

2. The Multiple System. Connecting the poles of the generator with two parallel wires, and placing each lamp in a branch running from wire to wire, as in the Edison and Maxim systems.

3. The Multiple Series System. Connecting the poles of the generator with two parallel wires, and placing a number of lamps in each branch running from wire to wire, as in the Sawyer-Mann system.

4. The Series Multiple System. Connecting one pole of the generator to a wire which, at the point at which light is needed, divides into a number of strands, each containing a lamp or lamps, and which strands again combine together in a single wire, which runs to the next point of division; and so on indefinitely, returning finally to the other pole of the generator, as in the Sawyer system.

5. The Secondary System. Passing the main current through the primary wire of an induction coil, in the circuit of the secondary coil of which the lamp is placed.

Alternating or intermittent currents are employed, and owing to the re-active earth inductions, this principle cannot be applied over any considerable territory. Moreover, it involves loss of power in the heating of the iron core of the induction apparatus, is an indirect application of power, and in electric, as in all other forces, direct application is found to be the most economical."

THE PARIS ELECTRICAL EXHIBITION.

We believe the following is a correct list of the English exhibitors at the forthcoming International Electrical Exhibition at Paris:—

Apps, Alfred, 433, Strand, W.C.
Ayrton, W. E., and John Perry, 68, Sloane-street, W.
Bolton, Lieut.-Col. Frank, 4, The Sanctuary, S.W.
Bourne, J. and Sons, Derby Pottery Works, near Derby.
Brotherhood, Peter, 56 and 53, Compton-st., Goswell-rd, N.
Blakey, Emmott, and Co., Northern Telegraph Works, Halifax.
Bright, E. B., 45, Gerrard-street, Soho, W.
Barraud and Lund, 41, Cornhill, E.C.
British Electric Light Company, Heddon-st., Regent-st., W.
Brush Electric Light Corporation, 74, Hatton-garden, W.C.
Cassell, Petter, and Galpin, La Belle Sauvage-yard, Ludgate-hill, E.C.
Carmichael, Sir James, 2, Throgmorton-avenue, E.C.
Coad, Theophilus, 78, Blackfriars-road, E.C.
Clark, Latimer, 6, Westminster-chambers, S.W.
Cohné, Sigismund, 65, Gracechurch-street, E.C.
Cooke, Conrad W., 5, Westminster-chambers, S.W.
Coxeter, J. and Sons, 23 and 24, Grafton-street East, Tottenham Court-road, N.W.
Crompton, R.E., and Co., 4, Mansion House-buildings, E.C.
Electric Light Agency, 52, Queen Victoria-street, E.C.
Elliott Brothers, 449, Strand, W.C.
Exchange Telegraph Company, 17 and 18, Cornhill, E.C.
Emmott, W. T., 41, St. Anne's-square, Manchester.
Fahrig, F. E., Southampton.
Faulkner, John, 13, Great Ducie-street, Manchester.
Foxcroft, W. M., 54, Compton-street, Clerkenwell, E.C.
Fildes, Augustine, 20, Lavin's-mead, Bristol.
General Electric Light Company, 7, Stevens-street, Tottenham Court-road, N.W.
General Post Office, London, E.C.
Gower Bell Telephone Company, 9, Great Winchester-street, E.C.
Garratt, B. C., 16, Finsbury-square, E.C.
Glover, W. T. and Co., 25, Booth-street, Manchester.
Gray, Matthew, 106, Cannon-street, E.C.
Hedges, Killingworth, 25, Queen Anne's-gate, S.W.
Henley, W. T., 8, Draper's-gardens, E.C.
Johnson, R. and Nephew, Bradford Ironworks, Manchester.
Kitson and Company, Airedale Foundry, Leeds.
Kirxik and Joel, 101, Rue de la Tour, Paris.
Laing, W., 217, Boulevard d'Enfer, Paris.
Latimer, Clark, Muirhead, and Co., 29, Regency-street, Westminster, S.W.
Macmillan and Co., 29 and 30, Bedford-st., Strand, W.C.
Newall, R. S., 130, Strand, W.C.
O'Lawlor, Luis de B., 11, Wharton-road, W. Kensington Park, W.
Paterson, E. J., 76, Little Britain, E.C.
Pulvermacher, J. L., 194, Regent-street, W.
Reid, Thos., 68, St. Andrews-street, Dundee.
Ransome, Head, and Jefferies, 9, Gracechurch-street, E.C.
Robey and Co., Lincoln.
Rustless and General Iron Company, 3, Queen-street-place, Cannon-street, E.C.
Reid Brothers, 12, Wharf-road, City-road, N.
Rudge, J. A., 1, New Bond-street-place, Bath.
Sabel, Max, 2, Coleman-street-buildings, E.C.
Saxby and Farmer, Canterbury-road, Kilburn.
Sax, J., 108, Great Russell-street, W.C.
Sabine, R., 7, Great Winchester-street-buildings, E.C.
Scientific Toy and General Novelty Company, Sun Works, Kirkwood-road, Peckham.
Siemens, Bros., and Co., 12, Queen Anne's-gate, Westminster, S.W.
Smith, F. J., Taunton, Somerset.
Swan, J. W., Gateshead-on-Tyne.
Stiff, J. and Sons, London Pottery, Lambeth, S.E.
Telegraph Construction and Maintenance Company, 38, Old Broad-street, E.C.
Thomson, Sterne, and Co., Crown Iron Works, Glasgow.
Thomson, Sir William, The University, Glasgow.
Webb, Brown Wolsey, 22, Harrington-square, N.W.
Whitecross Wire and Iron Company, Warrington, Lancs.
Whitley, J. R. and Co., 7, Poultry, E.C.
Wollaston, C. J., 28, St. Petersburg-place, Bayswater.
Wallis and Steevens, North Hants Iron Works, Basingstoke.

SCIENCE EXAMINATIONS.

The following were the questions set at the recent examinations of the South Kensington Science Department in the subjects specially interesting to our readers:—

SUBJECT IX.—MAGNETISM AND ELECTRICITY.

Examiners—Professor Frederick Guthrie and Professor G. Carey Foster, F.R.S.

The examination in this subject lasts for three hours.

FIRST STAGE OR ELEMENTARY EXAMINATION.

INSTRUCTIONS.

You are not permitted to attempt more than *eight* questions.

You may select only *two* in magnetism, *three* in frictional electricity, and *three* in voltaic electricity.

The value attached to each question is the same.

Magnetism.

1. Explain why it is that, although a magnetised steel needle floating on water turns so as to point towards magnetic north and south, it does not move bodily in either of these directions.

2. A bar magnet is held vertically, and two equal straight bits of soft iron wire hang downwards from its lower end. The lower end of each of these wires can by itself hold up a small scrap of iron; but if the lower ends of both wires touch the same scrap of iron at the same time, they do not hold it up. What is the reason of this?

3. A strong bar magnet is set upright, and a sheet of cardboard rests horizontally on the top of it. Describe and show by

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a sketch the way in which iron filings sprinkled on the cardboard arrange themselves.

4. If you were required to make a model to illustrate the magnetic properties of the earth by putting a bar magnet inside a ball of clay, show by a sketch how you would place the magnet, and explain how the magnetic properties of the model would answer to those of the earth.

Frictional Electricity.

5. If two insulated bodies, A and B, are rubbed together, and A becomes positively electrified, what is the electrical condition of B? (1) As to the kind of its electrification; (2) as to the amount of its electrification as compared with that of A.

6. If you have a penny piece fastened to the end of a stick of sealing wax, how could you give it a negative charge by help of a positively charged glass rod?

7. A pewter pot is insulated and electrified; if you touch it at different parts with a penny stuck to the end of a rod of sealing wax, what part of the pot will give the greatest quantity, and what part the least quantity of electricity to the penny?

8. How is it that you do not get a shock on touching the knob of a charged Leyden jar which stands on a cake of resin?

9. If you want to find out whether a body is electrified by seeing how it acts on an electrified pith ball hung by a silk thread, why is it a surer test that the body is electrified if it repels the pith ball than if it attracts it.

Voltaic Electricity.

10. Two large insulated flat brass plates are set facing each other and very near together. A wire from one of them is joined to the zinc end of a battery of a great many cells, and a wire from the other plate is joined to the other end (copper or platinum) of the battery. Without touching either the wires or plates with conductors the wires are removed from the plates, and the plates then moved to a distance from each other. What will now be the electrical condition of each plate?

11. When a plate of zinc and a plate of platinum connected by a wire are both dipped into the same vessel of dilute sulphuric acid an electric current passes along the wire. State and account for the effect of moving one of the plates into a separate vessel of acid.

12. One pole of a strong bar magnet is put through a copper ring and quickly taken out again. This is done repeatedly and quickly. Although the magnet and ring are not allowed to rub against each other the ring becomes slightly heated. Why is this?

13. Describe any one method by means of which an induced current in a wire may be kept up for some time.

14. Describe one (but only one) of the three following forms of voltaic cells:—Daniell's, Grove's, Bunsen's, stating what changes go on in it while the current is passing.

SECOND STAGE OR ADVANCED EXAMINATION.

Magnetism.

21. A straight bit of straw is hung vertically by a fine silk fibre and two magnetised sewing needles are thrust through it horizontally. Show what are the essential conditions in order—(1) that the needles may point in the same direction as each would do alone; (2) that they may point equally well in any direction (that is, that they may be astatic).

22. Two straight pieces, one three inches and the other five inches long, are cut from the same narrow strip of steel. After being equally magnetised, they are hung horizontally one at a time by the same fine glass thread, so as to rest in the magnetic meridian when the glass thread is not twisted. On turning the upper end of the thread half round (through 180deg.), the shorter magnet is deflected ten degrees from the meridian. Show how much the upper end of the thread must be turned to deflect the longer magnet ten degrees.

23. The axis of a dipping needle does not pass exactly through the centre of gravity of the needle. The needle will then show either more or less than the true dip. How can an accurate determination of the dip be made with such a needle?

24. A glass tube full of steel filings can be magnetised; but it loses its magnetism when the filings are shaken up after magnetisation. Explain this.

Frictional Electricity.

25. If a glass rod, strongly electrified by rubbing with amalgamed silk, is held at some distance from a pith ball hung by a silk thread, and having a slight positive charge, the ball is repelled by the rod. But, if the rod is brought sufficiently near to the ball, the latter is attracted. Explain this.

26. A metal pot, A, is placed on an insulating stand; a smaller metal pot, B, is put inside A, but insulated from it. A positively electrified metal ball is hung by a silk thread inside B, without touching it. The pot B is now connected for a moment with the earth, the ball is then removed; next, the pot A is connected for a moment with the earth; lastly, B is taken out from A without connecting either A or B with the earth. What is finally the kind and degree of electrification of the two pots as compared with the ball?

27. A glass rod which has been rubbed with amalgamed silk is held just below the spout of a metal funnel, from which shot drop one by one, without hitting the glass rod, into a cup of the same metal as the funnel. State and explain the result which may be observed—(1) if the funnel and the cup are each connected with a separate electroscope; (2) if they are both connected with the same electroscope.

28. A positively electrified metal ball is hung by a silk thread above a gold leaf electroscope. Would the divergence of the leaves be altered (and if so, how and why?) by putting (1) an unelectrified cake of resin, or (2) a metal plate held in the hand between the ball and the electroscope, so as not to touch either?

29. Describe Coulomb's torsion balance and the method of using it for the purpose of comparing the quantities of electricity in the same Leyden jar on two different occasions.

Voltaic Elcctricity.

30. Two points in the circuit of a voltaic battery are connected by two long covered wires arranged in multiple arc (that is, each wire would complete the circuit by itself if the other were removed). The resistances of the wires are in the proportion of 3 to 4. The one is now bent into a zig-zag, the other is wrapped in a continuous coil round a soft iron core. Show in what proportion the battery current is divided between the wires (1) when the battery contact is made continuously, (2) when it is made momentarily.

31. Is it possible for two currents in opposite directions to flow through the same wire at the same time in opposite directions? If so, state how; if not, state why.

32. You have two voltaic cells, each having a resistance of three units (Ohms), and an electromotive force of 1·1 unit (volt.). Show what is the strength of the current which would be produced in a wire of resistance 9·5 units (Ohms)—

I. By one of the cells alone.
II. By both cells connected in series.
III. By both cells connected abreast.

33. Describe and explain a method for comparing the electromotive force of two voltaic batteries.

34. Describe and explain any arrangement for causing a magnet to rotate continuously about a wire through which a current is passing, and show the relation between the direction of the current and the direction of rotation.

HONOURS EXAMINATION.

Full marks can only be got by answering all the questions.
The value attached to each question is the same.

41. Describe a method of making an accurate determination of magnetic dip; pointing out the sources of the chief errors which are liable to affect the result, and how they can be eliminated.

42. Describe a dynamo-electrical machine of which the current is always in the same direction, and explain its action.

43. The two poles of a battery of four cells connected in series, each cell having an electromotive force of 1·8 (volt.), and a resistance of 0·5 (Ohm), are connected by two pieces of the same wire arranged in multiple arc, one 14 yards and the other 23 yards long. Of this wire 100 yards have a resistance of 12 units (Ohms). Find the strength of the current in the battery and in each of the connecting wires.

44. What are the essential points to be attended to in the construction of a good tangent galvanometer and what precautions are necessary in using it in order to measure accurately the strength of an electric current? If two currents are measured by two different tangent galvanometers in two different places, say, in London and Berlin, show what you would require to know besides the deflection observed in order to compare the strengths of the two currents.

45. How does electrostatic induction affect the rate at which signals can follow one another through a submarine telegraph cable?

THE ORIENTAL TELEPHONE COMPANY (LIMITED).

The first ordinary meeting of this Company was held on Friday, June 3rd, and a full report appeared in our Special Edition of June 4th. The Chairman (John Pender, Esq., M.P.) pointed out the great progress already made by the telephone, and spoke very hopefully of its future. The work of the Company would be first developed in Egypt. It is expected that early in the winter months telephones will be at work in Cairo and Alexandria. A concession has been obtained from the Egyptian Government, and the prospect is very satisfactory. In India the Company has a free field for development. The Oriental Telephone Company and the Telephone Construction Company are working in harmony. The Hon. G. G. Hubbard also referred to the work in Egypt, and to the interest shown there in telephonic matters. Honolulu was also mentioned as containing 150 subscribers to the telephone system. A vote of thanks to the Chairman was proposed, seconded, and carried unanimously.

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THE ELECTRICIAN.

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THE SCIENCE AND ART DEPARTMENT.

It is necessary from time to time to take notice of the various means in existence for the propagation of scientific teaching. The most prominent of existing institutions is the Science and Art Department, having its central establishment at South Kensington. It may be well, perhaps, to state at once our reasons for calling attention to the working of the Science Department at this particular time. Year by year, during or about the month of May, this public department conducts a series of examinations all over Great Britain. Men who have been under the guidance of a master during the winter months are able to have their knowledge tested. The masters receive certain payments, which depend altogether upon the results of the examination. The annual examinations are just finished, and the results are being issued by the Department, and a good deal of dissatisfaction has already been shown concerning these results. In another part of this paper we reprint the questions set at the examination, so that the fairness of some of the allegations launched at the examiners may be easily considered. Referring to the questions in Advanced Voltaic Electricity a correspondent writes to the *Schoolmaster*:—"Since the Science Department has been in existence no such questions have been set, neither at any time have they run so much on one branch of this subject. I have taught the subject for many years, and, although I have had exceptional advantages for the practical study of the subject, I am utterly unable to answer the questions myself. If Professor Guthrie thinks that any sane teacher will follow him, he makes a mistake. He has already caused a great number of teachers to throw up the work, of whom Professor Tyndall annually reported well. I always thought . . . . that the examiners were to encourage a love of science among our artisans, and that some £390,000 was annually voted for that purpose. If the Department have any idea that they are really doing so, they can be soon enlightened by some member of the House asking for a return giving the names and occupation of, say, the students attending the metropolitan science classes. Having recently seen some twenty registers, I feel sure that not five per cent. belong to the artisan class . . . Having also looked over the recent Blue Books I find that of the £380,000 annually voted for 'the teaching of science and art' only some £70,000 is actually paid to the teachers." . . Another correspondent writes:—"I consider the questions proposed by Professor Guthrie in the Advanced Voltaic Electricity as utterly incomprehensible. To me they are on points far beyond the stage in which they were given, and I hold this to be unfair. That an examiner should have the power, much less be willing, to make teachers work seven months for nothing is not as it should be under a Liberal Government. . . . Purposing to carry the matter further, I am, &c., MEGAVOLT."

Whilst we are not called upon to defend the Science Department, or the action of the examiners, we think it but just to put the whole subject upon a fair footing, and to do this must direct attention to these letters sentence by sentence. We imagine that the instructions to the examiners specify exactly the number of questions to be set in each part of the subject, and we believe a syllabus is issued by the Department, giving very full details as to the course over which the examiners may ask questions. If this is true it is difficult to see how at any time there can be a great run on a particular branch. But we altogether deny that the questions in voltaic electricity show close signs of similarity. Question 30 is of importance now that the electric light is somewhat fashionable, as the veriest dabbler in electrical science ought to know something of multiple arc and its phases. It is almost needless to argue that Question 31 seems to have been set simply with a view to find out whether the candidate had or had not any original ideas, and if he had them to enable him to show his powers. Question 32 consists of variations played on Ohm's law, and surely a teacher of electrical science ought to be able to give an answer to Question 33, whilst almost every text book illustrates the method of performing the action mentioned in Question 34. Is it not a fact that men who pass this second stage in the first division are permitted to act as "teachers," and does it not strike one that the man who has had "exceptional advantages," who has "taught the subject for many years," is simply ignorant of the first principles of the science, and that the greatest blessing Professor Guthrie and his colleague could do for true scientific teaching, as opposed to maundering charlatanism, would be to make such men "throw up the work." "Megavolt" writes that to him the questions are totally incomprehensible. We can only say, then, that "Megavolt" must, like his brother writer, be utterly ignorant of the first principles of the subject. Whether the questions set are really good, or whether we ourselves would have framed such questions, is quite another matter. These men profess themselves unacquainted with the answers. We say that men in their position ought not to be so unacquainted.

With regard to Professor Guthrie having caused a number of teachers to throw up the work, it may be so. We have not the whole collection of Blue Books at hand, but we find in 1872 and 1873, under Dr. Tyndall's *régime*, the number of papers worked in this subject were respectively 4,317 and 6,438, while in 1878 and 1879, under Dr. Guthrie, the papers worked were respectively 9,421 and 10,835, and this increased number of papers implies, we should imagine, an increased number of teachers.

Perhaps, however, those who used to get on easily, finding

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they had to contend against increasing difficulties, have given place to men more able, more intelligent, and of wider and deeper range of knowledge.

The strictures relating to the expenditure of money, and to the class of students for whom payments are made, are, we fear, correct. The Department at South Kensington always had an unsavoury odour in certain directions, and will continue to have till more light is thrown upon the management. The whole affair is conducted about as badly as any system can be, but that the examiners are the culprits upon whose heads blame is to rest we deny. The examiners are compelled to work hard, and are not well paid, and we may say the same of the teachers. It is, however, passing the bounds of just criticism when men so woefully incompetent are able to decry what they do not, though they ought to, understand. The examiners in recent years have evidently attempted to stop the pernicious habit of cramming, and the men who have no other claim to scientific repute except that of being bookish to the finger ends are upon thorns lest their trade should be gone. Our motto is, hit out, hit hard, but hit fair.

ELECTRIC STORAGE OF DYNAMICAL ENERGY.

We reproduce the following letter from *The Times* of Thursday last:—

"Sir: The marvellous 'box of electricity' described in a letter to you, which was published in *The Times* of May 16, has been subjected to a variety of trials and measurements in my laboratory for now three weeks, and I think it may interest your readers to learn that the results show your correspondent to have been by no means too enthusiastic as to its great practical value. I am continuing my experiments to learn the behaviour of the Faure battery in varied circumstances, and to do what I can towards finding the best way of arranging it for the different kinds of service to which it is to be applied. At the request of the Conseil d'Administration of the Société de la Force et la Lumière, I have gladly undertaken this work, because the subject is one in which I feel intensely interested, seeing in it a realisation of the most ardently and unceasingly felt scientific aspiration of my life—an aspiration which I scarcely dared to expect or to hope to live to see realised.

"The problem of converting energy into a preservable and storable form, and of laying it up in store conveniently for allowing it to be used at any time when wanted, is one of the most interesting and important in the whole range of science. It is solved on a small scale in winding up a watch, in drawing a bow, in compressing air into the receiver of an air-gun or of a Whitehead torpedo, in winding up the weights of a clock or other machine driven by weights, and in pumping up water to a height by a windmill (or otherwise, as in Sir William Armstrong's hydraulic accumulator) for the purpose of using it afterwards to do work by a waterwheel or water pressure on a piston. It is solved on a large scale by the application of burning fuel to smelt zinc, to be afterwards used to give electric light or to drive an electro-magnetic engine by becoming as it were unsmelted in a voltaic battery. Ever since Joule, 40 years ago, founded the thermodynamic theory of the voltaic battery and the electro-magnetic engine, the idea of applying the engine to work the battery backwards, and thus restore the chemical energy to the materials so that they may again act voltaically, and again and again, has been familiar in science. But with all ordinary forms of voltaic battery the realisation of the idea to any purpose seemed hopelessly distant. By Planté's admirable discovery of the lead and peroxide of lead voltaic battery, alluded to by your correspondent, an important advance towards the desired object was made 20 years ago; and now by M. Faure's improvement practical fruition is attained.

"The 'million of foot pounds' kept in the box during its seventy-two hours' journey from Paris to Glasgow was no exaggeration. One of the four cells, after being discharged, was recharged again by its own laboratory battery, and then left to itself absolutely undisturbed for ten days. After that it yielded to me 260,000 foot pounds (or a little more than a quarter of a million). This not only confirms M. Regnier's measurements, on the faith of which your correspondent's statement was made; it seems further to show that the waste of the stored energy by time is not great, and that for days or weeks, at all events, it may not be of practical moment. This, however, is a question which can only be answered by careful observations and measurements carried on for a much longer time than I have hitherto had for investigating the Faure battery. I have already ascertained enough regarding its qualities to make it quite certain that it solves the problem of storing electric energy in a manner and on a scale useful for many important practical applications. It has already had in this country one interesting application, of the smallest in respect to dynamical energy used, but not of the smallest in respect to beneficence, of all that may be expected of it. A few days ago my colleague, Professor George Buchanan, carried away from my laboratory one of the lead cells (weighing about 18lbs.) in his carriage, and by it ignited the thick platinum wire of a galvanic *écraseur* and bloodlessly removed a nævoid tumour from the tongue of a young boy in about a minute of time. The operation would have occupied over ten minutes if performed by the ordinary chain *écraseur*, as it must have been had the Faure cell not been available, because in the circumstances the surgical electrician, with his paraphernalia of voltaic battery to be set up beforehand, would not have been practically admissible.

"The largest useful application waiting just now for the Faure battery—and it is to be hoped that the very *minimum* of time will be allowed to pass till the battery is supplied for this application—is to do for the electric light what a water cistern in a house does for an inconstant water supply. A little battery of seven of the boxes described by your correspondent suffices to give the incandescence in Swan or Edison lights to the extent of 100 candles for six hours, without any perceptible diminution of brilliancy. Thus, instead of needing a gas engine or steam engine to be kept at work as long as the light is wanted, with the liability of the light failing at any moment through the slipping of a belt—an accident of too frequent occurrence—or any other breakdown or stoppage of the machinery, and instead of the wasteful inactivity during the hours of day or night when the light is not required, the engine may be kept going all day and stopped at night, or it may be kept going day and night, which will undoubtedly be the most economical plan when the electric light comes into general enough use. The Faure accumulator, always kept charged from the engine by the house supply wire, with a proper automatic stop to check the supply when the accumulator is full, will be always ready at any hour of the day or night to give whatever light is required. Precisely the same advantages in respect of force will be gained by the accumulator when the electric town supply is, as it surely will be before many years pass, regularly used for turning lathes and other machinery in workshops and sewing machines in private houses.

"Another very important application of the accumulator is for the electric lighting of steamships. A dynamo-electric machine of very moderate magnitude and expense, driven by a belt from a drum on the main shaft, working through the 24 hours, will keep a Faure accumulator full, and thus, notwithstanding irregularities of the speed of the engine at sea or occasional stoppages, the supply of electricity will always be ready to feed Swan or Edison lamps in the engine-room and cabins, or arc lights for mast-head and red and green side lamps, with more certainty and regularity than have yet been achieved in the gas supply for any house on *terra firma*.

"I must apologise for trespassing so largely on your space. My apology is that the subject is exciting great interest among the public, and that even so slight an instalment of information and suggestions as I venture to offer in this letter may be acceptable to some of your readers.

"I remain your obedient servant,

"William Thomson.

"The University, Glasgow, June 6."

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A NEW CONTINUOUS CURRENT DYNAMO-ELECTRIC MACHINE.

By F. von Hefner-Alteneck. (Translated from *Elect. Zeit.*)

The growing importance of the supply of electric currents by means of machinery, induces me to direct your attention to a new dynamo-electric machine, by means of which the combination of a single induction current with continuous action is brought about in a manner different from that of any former machines.

Whilst in these the single current was produced in rapid sequence from the same magnetic field, in the new machine the currents produced immediately after each other in different parts of the machine are united into one continuous current.

Although in the new machine the arrangements by which the separate currents are produced may be of different kinds, and may be copied from those of existing machines, I will only describe the form in which you see the machine before you, in which it is connected with the alternate current machine (Siemens and Halske's patent). In order to make it clearer, I must give a short description of this alternate current machine, although I have already done so on a former occasion.

Fig. 1.

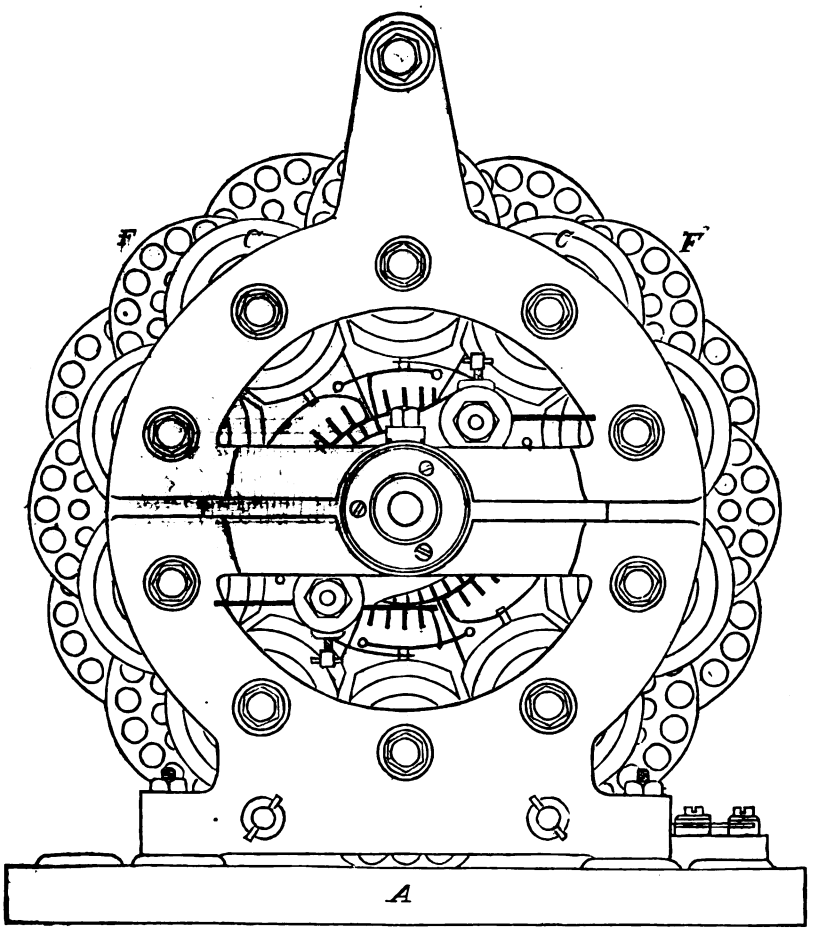

Fig. 3 shows a part of the cross section of the machine, and I will at the same time refer to Fig. 2, although this is a longitudinal section of the new continuous current machine.

On the base plate A, Fig. 2, are fixed two iron supports B, B, the form of which is shown by the drawing. On the inner side of each of these supports are fixed an equal number of electro-magnets, C. C., the poles of which, facing each other, are spread out into suitably shaped plates, N.S., N.S. The polarity of these electro-magnets is so managed that each one has the opposite polarity of the one facing it, and of those on the same side right and left of it.

From this arrangement it results that the pole plates of the pairs of electro-magnets opposite to each other form powerful magnetic fields, of which each has the opposite polarity to the plate next to it.

Through the magnetic fields pass induction coils which have a wooden core, and are connected with the axle A, filling up as far as possible the space between the magnetic fields. For the sake of distinctness, only two of these coils are shown in Fig. 3, and these with only two layers of wire on each. When the one half of the coil is between one pair of pole plates, the other half is between the pair next to it. Thus, in the one half of the coi an upward current is induced, and a downward one in the other half, which currents mutually strengthen each other. When the coil is between the two magnetic fields there arise induced currents in the two halves of the coil, which unite soon afterwards in a current in the reverse direction. As the revolving coils are equal in number to the magnetic fields, the electric current changes its direction in all the coils at the same time. Answering to the different polarities of every two adjoining magnetic fields, the currents which circulate round two coils which follow each other are always opposed in direction. The ends of the armatures are connected with each other in such a manner that, by the direction of the conductor formed by them, the current circulates in each coil in the direction from that in the adjoining coil; and thus the sum of the force of the currents entering each coil at the same time is obtained.

In Figs. 4 and 5, for the sake of clearness, the coils introduced into the circuit are distinguished to the eye, those in which the current flows in one direction being coloured black, while those in which its course is opposite are left white. The alternate polarity of the magnetic fields is shown in the same way. For the same reason, the coils and the magnetic fields are shown concentrically to each other, the diagram only representing with accuracy their relative angular position. With reference to these illustrations, the following must also be borne in mind. Each white coil which approaches a white magnetic field, and each black coil approaching a black one, develops a current in the direction of the rotation of the machine; every white coil approaching a black field, or *vice versâ*, on the contrary, develops a current whose motion is opposed to that of the machine. To put it more simply, coils approaching fields of the same colour induce a current in the direction of the revolution; approaching fields of the opposite colour, they induce a current in the reverse direction. It will be seen from Fig. 4 that at the moment of the revolution which it represents, the coils are approaching magnetic fields of the same colour, whilst in the eighth of a revolution more the reverse will take place; so that, according to my preceding explanations, the power of all the coils is united to produce a positive or negative current, while, by the continued revolution

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of the spindle which carries the coils, strong currents will be produced, rapidly following each other in opposite directions, constituting an alternating current.

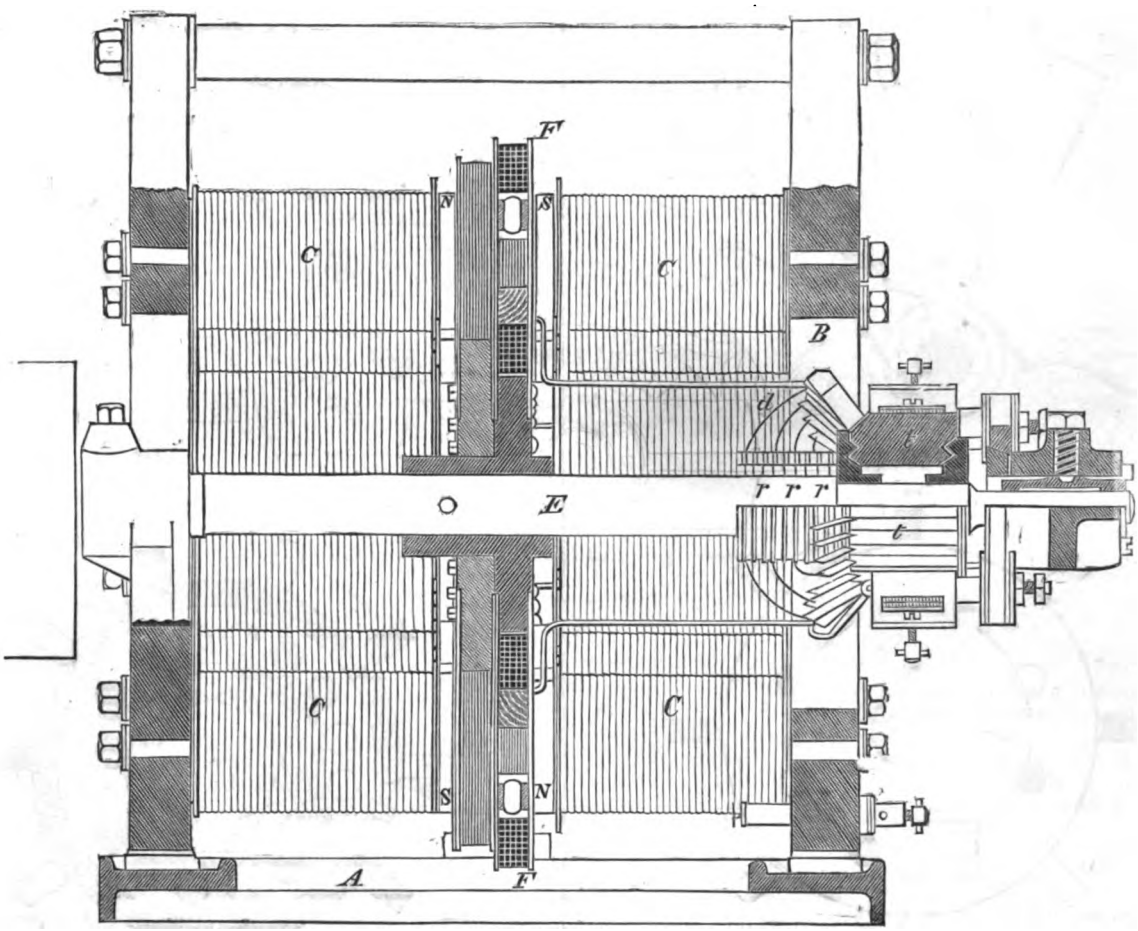
The new dynamo-electric machine (Figs. 1 and 2) has almost the same appearance as the alternate current machine. It differs from it, however, in the important particular of not having an equal number of magnetic fields and coils. Although the numbers can be varied, I will assume that there are 10 magnetic fields and 8 induction coils, as shown in Fig. 5. As the magnetic fields are not the same distance apart as are the rotating coils, only two of the latter can approach the magnetic fields at the same time, the remaining six coils being more or less distant. Thus, on the rotation of the coil-frame, the sum of the electric force does not enter all the coils simultaneously, as in the case of the alternate current machine; but enters successive coils at successive moments. It results that all these currents are collected in one continuous current, because no opposed action, or arising of any single current, takes place.

With this object, the ends of the armatures are connected in such a manner that the wire on all the coils forms a closed circuit; and it is so arranged that each coil is wound in the reverse direction from the preceeding. Accordingly, the currents existing in two adjoining coils unite, as soon as the latter approach simultaneously the two corresponding magnetic fields, which of course have different polarities. This has been shown already in Fig. 5.

The spindle of the machine carries a commutator, similarly constructed to that of the well-known dynamo-electric machine, which in this case consists of 40 plates, insulated from each other and from the spindle. These commutator plates are connected into 8 groups, in such a manner that each contains 5 plates, the groups being separated by 7 plates placed between. These connections are made by 8 insulated metal rings, *r*, Fig. 2, fixed on the spindle from which 5 wires, *d*, lead to the commutating plates of the respective groups. From the wire between every two coils a connecting wire passes to one of the groups of commutator plates, so that each wire is connected to the corresponding group. The current is carried away at two diametrically opposite points of the commutator, on which springs, brushes, or bunches of wire slide, as in the ordinary machine. The action of the machine can be easily understood from Fig. 5, in which, however, I would remark again, the parts are only shown in their correct angular relations. In addition to the coils and magnetic fields, the commutator with the insulated metal rings is shown by the Figs. 1 to 8, &c. The fixed springs, sliding on the commutator, are shown by the signs + and −; and the connecting wires between the armature of the separate coils by the Figs. 1 to 8 between them. The connections between the coils and the commutator are left out, in order not to complicate the diagram. It must be remembered that these are arranged in such a manner that each of the wires 1 to 8 is connected with the five commutator plates bearing the same number. If, for example, the coils with the commutator are imagined as revolving in the direction of the hands of a clock, whatever momentary juxtaposition of them with the magnetic fields is taken, a line drawn through the centre, dividing the figures into two halves, will always be found to have on the one side coils approaching similarly coloured magnetic fields, and on the other, approaching those of opposite colours. This is shown by a dotted line in the diagram. All the coils in the one half give a positive current in the direction of the revolutions; those in the other half in the reverse direction. From both halves a positive current will be supplied to the point 7, a negative current passing to point 3; so that an accumulation of positive electricity takes place in the one, and of negative in the other. It is further found that in the position shown in the diagram, the commutator plates 7 and 3 (with which the wires of the same numbers are connected) are on each side under the sliding springs. These carry off an electric current into the conductor connecting them. It will also be found that in any other position of the revolving parts, the imaginary division-line selected passes through the two points of the inner closed circuit which are in connection with those commutator plates above which the sliding springs stand at the same moment. Therefore, it follows that a continuous positive current always passes from the spring +, whilst from that marked — a continuous negative current is obtained.

This machine has this in common with the earlier dynamo-electric machines, that in both the electric current is in two

Fig 2.



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halves, flowing in parallel lines. While, however, in the former, the two currents maintain their position, in the new machine they revolve in an opposite direction, and much faster than the spindle of the machine. Nevertheless, the ends of both streams remain in continuous connection with the immoveable commutator brushes, on account of the independent position of the commutator plates.

It is evident that the number of the coils and magnetic fields may be greatly varied, it being remembered that there must not be the same of each.

The following is a generalisation of this machine.

Taking for granted that there is an equal number (n) of the rotating coils, and that the number of the magnetic fields is $n + 2$, then the commutator contains $n\left(\frac{n}{2}+1\right)$ parts. Between the armatures of every two coils are similarly $\frac{n}{2}+1$ parts of the commutator, with a conducting connection, which parts are always in similar positions relatively to each

FIG.3.

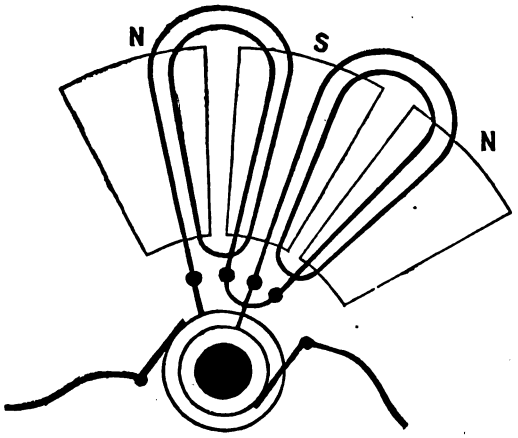
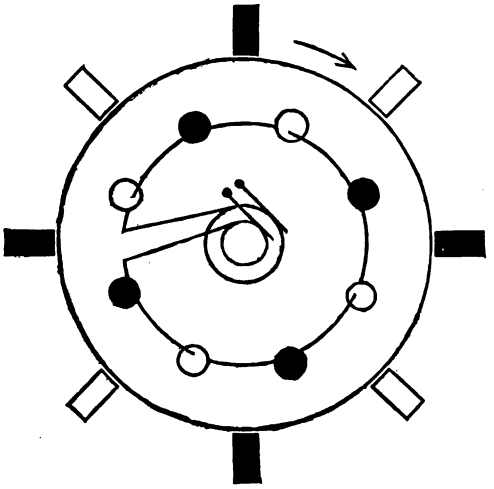


FIG.4.



other. The current is carried off by the sliding contact, at two diametrically opposite points of the commutator plates.

Instead of more magnetic fields than coils being employed, fewer can be used. For example, in the above formula — can be substituted for +; and the difference in number need not be 2. I will not explain this further. Whilst retaining the number of the magnetic fields, that of the coils may be increased, *e.g.*, doubled. This doubling of the coils gives the important advantages that, on account of their continual reaction on the electro-magnetic pole, the action of the machine will be better, and their movement smoother, and the sparks on the commutator will be small. The coils are arranged in two series, so that one coil half covers the end of the opposite coil in the other series, as shown in Figs. 1 and 2. Fig. 6 shows the plan of such a machine. It will be seen that the coils into which the currents enter in immediate succession do not follow each other with spaces between, but stand in zigzag fashion along a circle, and are arranged one after the other in the circuit of the current. On that account the connexion between the coils, which in Fig. 5 appeared as a circle, is here (Fig. 6) shown as a line passing backwards and forwards across the circle. The commutator has 80 parts.

With this exception, the colours, figures, and letters in this diagram bear the same significance as in Fig. 5, which may be referred to. In the position shown, the dividing line passes through the connecting points 3 and 11, and the momentary direction of the current is shown by arrows.

The new machine, at least in the form in which you see it, and which I have described, may be considered as an improvement of the Siemens and Halske alternate current machine, and, therefore, has certain advantages in common with it. Amongst these are:—

The poles of the electro-magnets which form the magnetic field are directly charged by the continuous current circulating through the armatures of the magnets; whilst in the ordinary continuous-current machines the one pole (and that the most important for the action) was magnetised by magnetic induction to a less degree. The result is that the resistance of the armature of the electro-magnet is better utilised than in the other machines.

FIG.5.

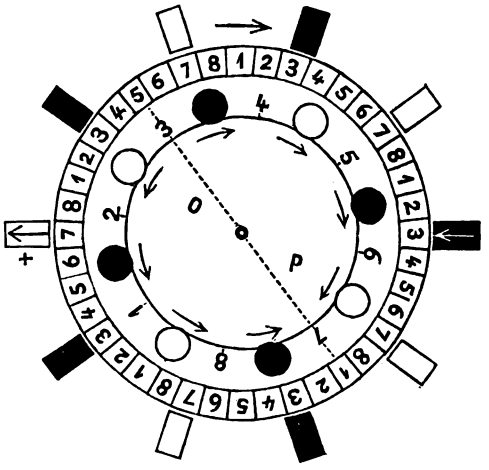
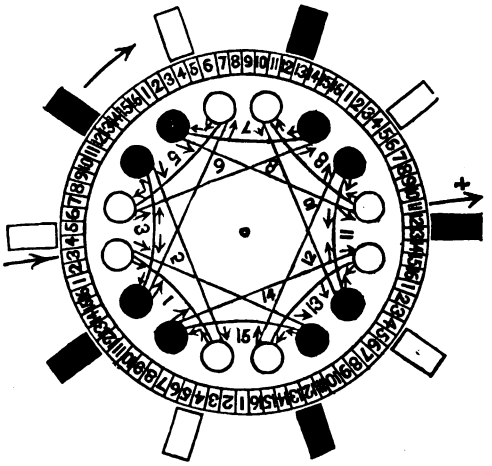


FIG. 6.



The revolving coils contain no iron, and no magnetic derangement or alteration of the poles takes place in the whole machine, and there is thus no loss of power. Such a derangement is shown —where it occurs—by the heating of the iron, and can be reduced very much by constructing the iron parts of separate sheets or wires. In the present Gramme and Siemens and Halske machines, the heating of the iron is moderate, as in a revolution polar variations only take place twice. If, however, an iron ring or a single piece of iron were allowed to rotate between the magnetic fields of the machine before us, as in the Alliance or Wilde machine, the heat of the iron would become considerable, the working-power would be reduced, and the relative motive-power much increased.

A further advantage consists in the simplicity of the armature, and the possibility of thoroughly insulating the coil-armatures from the metal parts of the machine. Whilst the armature of the induction-coil of the ordinary dynamo-electric machines requires to be wound by hand, that in the present machine is easily wound in a lathe.

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The heating of the machine is very small in proportion to the strength of the current, as actually no iron is heated by it, and the coils are cooled by the air. The best proof that this is the case is that in 600 alternate current machines supplied by Siemens and Halske there has been no faulty insulation of the rotary coils.

It may be asked what advantages these alterations of the alternate current machine offer when applied to one for continuous current. In answer, I must say something about the quality of the two kinds of currents.

It is well known that, since the introduction of the electric light into practical use, both alternating and continuous currents have been employed for its working. Each has its advantages and disadvantages. As with the first the single currents follow each other very rapidly, both forms produce practically the same light, only in consequence of the greater consumption of the upper carbon by the continuous current, in this case the light is thrown more downwards. The proportion of the illuminating power to the engine-power consumed is in both cases about the same; but the light produced by the alternate current gives a better result if the illuminating power is measured in the horizontal plane of the rays of light. The light from a continuous current has the advantage, however, if the rays are included which radiate away from this plane. This is not of great value in practice, as, by the use of opal globes, or reflecting lamp-tops for the former system, this difference is much reduced.

In this review, the consumption of power by the primary machine, *i.e.*, the small dynamo-electric machine, which supplies the current for charging the electro-magnets, is taken into consideration in the case of the alternate current machine. In that for continuous current, the primary machine is unnecessary, as the light-current charges the electro-magnet. This may appear to be a great advantage, but it has the disadvantage that machines which charge their own electro-magnets are much more sensitive to every variation of resistance in the circuit than those in which the magnetism is not dependent upon a variation of the strength of the current. In the former it is more difficult to obtain a steady light; and any carelessness in attending to the lamps may result in such an increase of the current that the machine becomes too hot, and is injured. I prefer—at least for large systems—when employing a continuous current, to use a primary machine for charging the electro-magnets. There are machines which include the primary machine in themselves; that is to say, they have a second circuit, with a separate commutator; but this practically is the same thing. The alternate current machines have the advantage of simplicity, as by them the current can be employed as it is produced, and they require no commutator.

This is the most critical part of a dynamo-electric machine, because of the impossibility of avoiding the production of sparks, and also because faulty insulation may result in serious damage and rejection of the machine. A great advantage of the Siemens and Halske alternate current machine is the possibility of passing several independent currents through it, so that one group of lamps may be extinguished without interfering with any of the others which are driven by the same machine.

It will be seen that neither machine possesses an absolute superiority, and also that the available power is not the only point to be considered. Differential lamps have been established with currents of both kinds. It is only necessary to proportion the thickness of the wire in the armature to the power required for the lamps, and to arrange the two together. This has been carried out by Siemens and Halske. Whilst electric lights can be produced by both classes of currents, many departments of practical electricity are closed to the alternate current machines. Among these are all uses of the electric current, in which the power of the current is employed in simple proportion, as for example, galvanoplastie, the refining of metal by electrolysis, the electric transmission of force, and telegraphy. The latter is at present not much considered, but I do not doubt that the employment of one or more dynamo-electric machines as a substitute for batteries is quite practicable.

The machine which you see before you has been employed for the production of distributed light, and has given good results, although it is the first attempt to carry out the new principle. It will supply illuminating power to four 700-candle lights, with an expenditure of 7 h.-p. The light, it must be remembered, is to be measured in the horizontal plane of the rays. Although these figures are satisfactory, I will not fall into the mistake, often made in describing new machines, of saying that this is better than any others. It is too new to be compared with older systems, not having any long practical results to show; and further experiment must prove their relative values. Nevertheless, I believe that with the uniting of currents arising from different poles of the machine, a new principle is discovered, which will prove of importance in the further development of dynamo-electric machines.

DR. HIGGS'S ELECTRIC LIGHT.

GENERATORS AND ENGINES DISPENSED WITH—ELECTRICITY STORED IN CELLS.

At No. 36, East Twenty Third-street lives Dr. Paget Higgs, an English electrician and electrical engineer, who for ten years was at the head of the laboratory of the celebrated Wheatstone, and is the author of a standard work on "The Electric Light in Its Practical Application." Dr. Higgs is himself the inventor of a system of electrical lighting which possesses some novel features. He claims to have obtained such remarkable economical results as the realising of 715 candles per horse-power with only 40-candle lamps. Those who have accurately measured the energy absorbed by one of Mr. Edison's 8-candle lamps find it to be equal to the product of 40 Bunsen cells, while Dr. Higgs, according to a statement given last evening, runs a 40-candle lamp with from 6 to 8 Bunsen cells. The novel feature of Dr. Higgs's system, however, is an ingenious device for storing electricity, similar to that of M. Faure, which was recently tested by Sir William Thomson at the University of Glasgow.

When Dr. Higgs came to apply this invention to the storage of electricity for the operation of lamps, he was confronted with the grave difficulty that the discharge was not uniform, and was very rapid, unless a considerable proportion of the energy was consumed by interposing an artificial resistance. Bubbles of gas are formed in the Faure battery in such number as to produce pressure, and finally to break the sealing. This trouble, however, was overcome. Dr. Higgs produced small cells of the power of 3·1 volts each, which discharge their energy with the uniformity of the best batteries. His next procedure was to devise a lamp which could be operated by such charged cells without employing any generator or steam-power, thus reducing the problem of lighting a parlour or library with electricity to the simplest possible terms by dispensing with these expensive items. For this purpose he experimented for many months with the incandescent principle, which he finally demonstrated to be impracticable owing to the high resistance of the solid carbon or metal, as compared with that of the carbon vapour formed between the two poles. He ultimately fixed upon a novel arrangement which he styles the infinitesimal arc; that is, the distance between the two poles of the lamp is so minute as to be scarcely perceptible to the unaided senses, thus offering the least resistance compatible with the generation of a high temperature and the formation of a brilliant light by the incandescence of particles of carbon. In this manner he constructed a lamp of 40 candles that could be operated by secondary piles of an energy equal to that of seven or eight Bunsen pint cells. The novel feature of the system thus consists in the application of stored electricity to the production of light, so that a gentleman wishing to light his house or his library by means of that agent has only to buy the lamps and cells required for the purpose. The materials composing the latter are very inexpensive, and the first cost of the plant for domestic purposes is thus reduced to a minimum. No engine is required, no engineer, no generator. The cells may be recharged for a trifle when their energy is exhausted, or renewed for a trifle when they are no longer serviceable, and the lamps are simple in their construction.

Dr. Higgs is now having his parlour, at No. 36, East Twenty Third-street, fitted up to illustrate the practical operation of the method which has been thus briefly explained, and expects to be ready to show his light to a few invited guests and experts some evening during the coming week. The cells will be contained in one of the little compartments of the writing-desk, conductors leading from it to a 40-candle lamp on the desk itself. His objection to the use of steam-power and generators in electric lighting is that every variation in energy is transmitted to the lamp in geometrical ratio. That is, if the variation in the generator caused by the sliding of a belt or any inequality of that kind were to be represented by 2, the variation in the intensity of the light consequent upon it would be represented by 16. It is this fact, he says, which has given electrical engineers most of the trouble they have encountered in producing a steady and uniform light. Dr. Higgs says he can store within the space occupied by an ordinary walking-stick the energy required to supply an electric lantern to guide the traveller on his way of a murky night, or transform the baton of the policeman into a marvel carrying a secondary battery at one and an electric lamp at the other.—*New York Times*, May 20.

THE THERMO-ELECTRIC NEUTRAL POINT.

By A. Partz.

While engaged of late in making a series of thermo-electric experiments, I had repeated occasions to fully convince myself that the electric currents resulted purely from a conversion of the applied heat. I also obtained a little more light on the conditions under which that conversion took place, and detected various

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errors in the statements of former investigators of the subject. For instance, there is evidently something wrong about the iron line in the diagram on p. 178 in the highly meritorious book of Professor Jenkin; indeed, the whole diagram seems to need a revision. This may be shown by a few simple trials. Take a platinum and an iron wire, each about 1 mm. thick and at least 15 cm. long (so that the heat be not conducted too readily to the pole connections), twist them together and hammer the twisted ends a little flat, so as to prevent them from untwisting when heated, form a circuit through a galvanometer, and introduce the twisted end gradually into a strong flame. You will see the needle steadily deflecting in the same direction until the wires have attained at their junction a bright red heat, when it suddenly stops, and it will then not move either one way or the other, even though the heat be raised considerably higher by the aid of a blowpipe; and, when you withdraw the couple from the flame, the needle will steadily recede to 0 degrees. There is, then, no reversion of the current, no neutral point; but there is a point of maximum force. In making the experiment with wires of argentine and iron, and of argentine and copper, the same result will be obtained in a more striking manner, because of the greater strength of the currents; and here it will be found that the maximum force of the couple of argentine and copper is not much inferior to that of argentine and iron. With couples of silver and iron, copper and iron, and aluminium and iron, I did observe a reversion of the currents, which went first from the former to the latter metals through their heated junctions, and then *gradually* turned the other way; but here also occurred the same points of maximum force beyond which the currents could not be pushed by an increase of heat.

These and other trials led me to conclude that I had got on the track of a new law, which may be stated as follows:—

"The thermo-electric current of a metallic couple attains its maximum strength when the molecular structure of one of the metals begins to change, at the heated junction, from that of solidity to that of plasticity when the metal begins to take up latent heat."

To test this law at a moderate temperature, and in such a way that the change in the state of aggregation of one of the metals could easily be observed, I made the following experiment:—I cast bismuth in a porcelain tube 1 cm. in diam. and 16 cm. long, inserting at each end a copper wire, one passing through a plug of plaster. Having connected the wires with a galvanometer, I held the tube in an inclined position, with its open end over an alcohol flame. The moment when the bismuth began to soften, so that the inserted wire became slightly loosened, the needle stopped advancing; and, although I then increased the heat far beyond the melting point of the metal (the lower end of the tube being placed in water), the needle remained at the same spot.

As regards the reversion of thermo-electric currents, I am confident that future investigations will prove them to be due to such molecular changes as are, with respect to some metals, already known to take place at comparatively low temperatures. Thus, while zinc is malleable at 150 degrees C., it becomes brittle at 200 degrees, and that change just coincides with the inversion of its current with iron.—*The Journal of the Society of Telegraph Engineers*, May, 1881.

VISIT TO THE WORKS OF MESSRS. JOHNSON AND PHILLIPS.

On Saturday last Mr. John Pender, M.P., made an inspection of the Telegraph Works of Messrs. Johnson and Phillips at Charlton, accompanied by Lord Tweeddale, Sir James Anderson, Mr. James Pender, Mr. Hall, of the United Telephone Company, the Chief Electrician, and Secretary of the Eastern Telegraph Company, &c. After an inspection of their new building, which has two floors of over 150 feet in length, and is being fitted with new machinery for the manufacture of electric carbons, &c., the different processes of iron buoy making were seen. A large plate having first been sheared to the templates, was furnaced, and bent in the mould block.

Passing through the wood-working department, the stranding and taping machines, chiefly engaged in making cables for electric lighting and torpedo purposes, were next inspected. On another floor of the same building several thousands of patent fluid insulators were being tested previous to being packed for transport to the Persian Gulf, to the order of Colonel Champain, for the Indo-European Telegraph Department.

Two different forms of pianoforte wire deep sea sounding machines were inspected. Attached to one of these, a detaching sinker was shown in operation, the latter being the ingenious invention of Mr. C. H. Phillips, of the Eastern Telegraph Company, and has done good service in recovering samples of the bottom in deep soundings.

The large workshop devoted to the making of tapes for telegraph purposes engaged considerable interest, the patent processes of this manufacture being duly exemplified.

In the forge a large grapnel for deep-sea service was being welded up, and several forms of grapnels were seen in different stages of manufacture.

The brass and zinc foundry and the various machine shops were next visited; a steam-hauling machine also attracted considerable attention. This machine is worked by a small three-cylinder engine, and the starting is governed by a single lever.

We believe that the Eastern Telegraph Company have several of these machines on board their repairing vessels in the Mediterranean and elsewhere.

Several other departments having been visited, the guests partook of luncheon in the elegant reception room, the decorations of which are in character.

Previous to the departure of the guests several successful photographic portraits were taken by the aid of the Brockie electric lamp, of which we believe Messrs. Johnson and Phillips are the sole manufacturers.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices June 8.		Business Done Week Ending June 8. Highest.		Lowest.	
Anglo-American	55¼,	56¼	56		55¼	
Do. Preferred	86¼,	87¼	87¼		86¼	
Do. Deferred	27¾,	28¼	28¼		27¾	
Brazil Submarine	10¾,	11	11		10¾	
Cuba	9¼,	¾	—		—	
Do. Preference	16½,	17	—		—	
Direct Spanish	3¾,	4¼	—		—	
Do. Preference	13½,	14½	—		—	
Direct United States Cable	11,	¼	11¼		10¾	
Eastern Telegraph	10¾,	¼	10¾		10¾	
Do. 6 per Cent. Preference	12¾,	13¼	12¾		13	
Do. 5 per Cent. Debentures, 1899	106,	109	107		107	
Eastern Extension	11¼,	¾	11¾		11¾	
German Union	11¼,	12	12		11¾	
Globe Telegraph and Trust Company	6¼,	¼	6¼		6¼	
Do. Preference	12½,	¼	12½		12½	
Great Northern	13,	¼	13¾		13¾	
Indo-European	28,	29	—		—	
Mediterranean Extension	2¼,	¾	—		—	
Do. Preference	9¼,	10¼	—		—	
Reuter's	11,	12	—		—	
Submarine	270,	290	285		285	
West India and Panama	2¼,	¼	2 7-16		2 5-16	
Do. 1st Preference	7¼,	8	7¼		7¾	
Western Brazilian	8¼,	¼	8¼		—	
West. Union 7 per Cent. 1st Mortgage	120,	125	—		—	
Do. 6 per Cent. Sterling Bonds	106,	110	—		—	

TRAFFIC RECEIPTS FOR MAY, 1881.

Companies.	May, 1881.	May, 1880.	Increase.	Decrease
Anglo-American Telegraph Company	£49,880	41,970	7,910	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	3,000	2,972	28	—
Direct Spanish Telegraph Company	1,547	1,334	213	—
Direct United States Telegraph Company	16,630	13,990	2,640	—
Eastern Telegraph Company	43,872	42,963	909	—
Eastern Extension Telegraph Company	29,523	26,570	2,953	—
Great Northern Telegraph Company	21,600	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

JOURNAL OF THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

Edited by Professor AYRTON, and containing Original Illustrated Papers, with Discussions, and Abstracts of the more important Current Foreign Electrical Literature.

No. 36.—Applications of Dynamo-Electric Machines to Railways. By Lieutenant P. CARDEW, R.E.
Prevention of the Breaking of Fibres in Wearing from their being Electrified. By E. B. BRIGHT.
Telegraphs in Japan. By J. MORRIS.
Application of Electricity to Domestic Lighting and Heating. By ST. G. LANE FOX PITT.
Electric Light Current Galvanometer. By Professors AYRTON and PERRY.
Dynamometer for Measuring the Power Absorbed by Dynamo-Electric Machines, or by other Machinery. By Professors AYRTON and PERRY.
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No. 35.—Inaugural Address on the Growth of the Science of Electrical Measurements, and on the Value of the Ohm. By the President, Professor FOSTER, F.R.S.
Electric Tides. By A. J. S. ADAMS. With Six Sheets of Illustrations.
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COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
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QUOTATIONS WANTED for immediate supply of ordinary TELEGRAPH INSULATORS, without iron fittings.—Address, R. E. CROMPTON, Mansion House-buildings.

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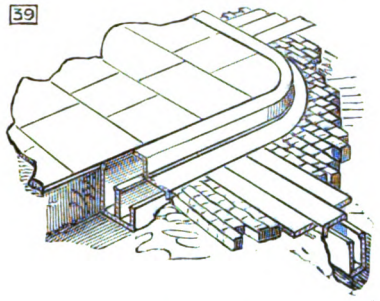
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

39. STREET CURBS AND GUTTERS FOR THE RECEPTION OF TELEGRAPH WIRES, *H. J. Haddan.—Dated 4th January*, 1881.—(*A communication from J. D. Townsend*).—(*Complete.*) 4*d.*

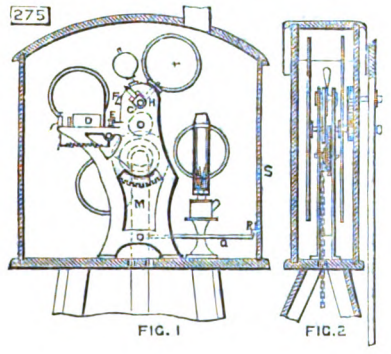
This relates to a conduit for telegraph and other conductors, consisting of a flanged case or chamber forming a street curb, a parallel flanged



chamber forming the gutter, the chamber being suitably connected together at the side and ends, and covered with a removable cover forming a step and gutter piece for the curb and gutter.

275. IMPROVEMENTS IN ELECTRIC SEMAPHORES FOR RAILWAYS, *W. R. Lake.—Dated 21st January*, 1881.—(*A communication from F. R. F. Brown.*) 6*d.*

The object of the inventor is to provide simple and effective mechanism for operating railway signals, and consists partly in a simple combination of gearing operated by a weight, and so arranged that the strength of the electro-magnet need not be in proportion to the said weight. D



is the electro-magnet suitably located to actuate a properly magnetised lever E, which is so placed that when in a certain position it supports the arm F on the plate G, holding the dog H in gear with the ratchet wheel, and thereby supporting the weight without sustaining any strain therefrom. Thus a very weak electro-magnet will answer the purpose, while at the same time as heavy a weight as the material of the gearing will sustain may be hung upon the chain M. Thus the motion of the semaphore can be depended upon, provided the weight is wound up, to ensure which he pivots to the lamp stand or any other suitable place a lever, Q, one end of which is forked to allow the chain to pass freely through it, the other end being crooked, so as to engage with the catch R secured to the door S, as shown. When S is closed the lever Q securely locks it, as the forked end of Q is heavier than the other. Fig. 1 gives a side elevation; Fig. 2, a cross section of apparatus. In Fig. 2 O is the semaphore arm.

3964. IMPROVEMENTS IN MAGNETO OR DYNAMO-ELECTRIC MACHINES, *P. Jensen.—Dated 30th September*, 1880.—(*A communication from T. A. Edison.*) 10*d.*

The principal improvements described relate to (1) the commutator brushes. Each brush or spring is secured at an angle in a holder, so that the brush bears obliquely upon the commutator. The holder is pivoted on a U-shaped jaw. At the pivotted point of the holder is a chamber, in which is a spring, whose force is exerted to throw the brush upon the commutator. Figs. 1, 2, and 3 show the arrangement. (2) Describes how the prime motor is preferably connected directly to

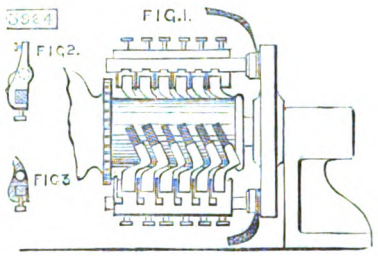
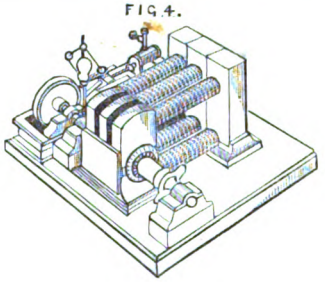


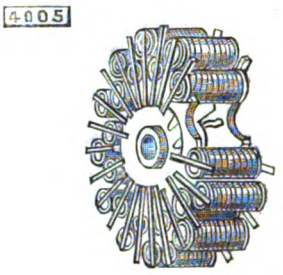
FIG. 4.



the dynamo machine, and both mounted on one base as on Fig. 4. Another part of the invention describes the means of communicating motion from the rotating armature to the driven mechanism without the use of belts, gear or similar devices. Further, the coil is so made as to be removed or repaired without disturbance of the remainder. This is accomplished by making of wire only that portion of the coil which is upon the operative face, the wires of a coil being connected at the ends by metallic plates, fastened to an insulating base, and insulated from each other.

4005. IMPROVEMENTS IN DYNAMO-ELECTRIC OR MAGNETO-ELECTRIC MACHINES, *E. G. Brewer.—Dated 2nd October*, 1880.—(*A communication from A. J. B. Cance.*) 6*d.*

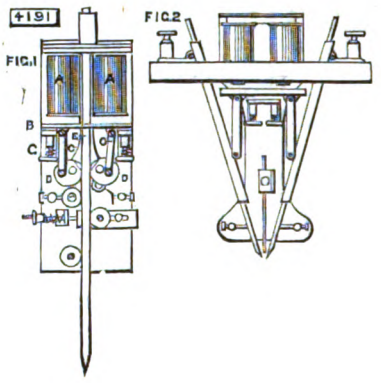
This apparatus is essentially composed of one or several induction crowns or rings on a support



in the form of a wheel mounted on the shaft of the machine. The figure shows a double crown of these induction coils.

4191. IMPROVEMENTS IN ELECTRIC LAMPS, *G. P. Harding.—Dated 15th October*, 1880. 6*d.*

The object of the invention is to assure the relative position of the electrodes in electric lamps, utilising the effect of gravity and diverted portions of the current in connection with electro-magnets. In Fig. 1, assuming that the lamp is at rest, and carbon E not resting on lower carbon, as shown, directly connection is made from machine to the lamp a portion of the current goes through the magnets A A, armature B is attracted, and actuates cams



D, which open and release the pressure on the carbon; the current now passing between the two carbons, the magnets become inactive, and the springs G G pull back the armature and actuate the cams in the contrary direction, causing them to close and lift the carbon a short distance and establish the arc. Fig. 2 shows another arrangement, with two carbons placed at an angle, a third carbon being used to regulate the arc; this prevents the carbons descending too far, the arc being regulated by the thickness of the third carbon.

IMPORTANT TO TELEGRAPH COMPANIES.

THE SANITAS COMPANY (Limited), of Bethnal Green, E., have received the following gratifying letters upon the subject of Sanitas and its uses at Foreign Telegraph Stations:—

"THE MANAGING DIRECTOR, THE SANITAS COMPANY (LIMITED). "February 4th, 1880.
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Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

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FRANCIS RAVENSCROFT, Manager.

Southampton-buildings, Chancery-lane

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SLIP

TRANSVAAL.—Telegraphic communication with the Transvaal is now restored.

ELECTRIC LIGHT IN SYDNEY.—Successful experiments have been made with the electric light at the volunteer encampment at Middle Head.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY. — The traffic receipts of this company for the week ended the 10th June amounted to £3,072.

THE ELECTRIC LIGHT IN PARIS.—*L'Electricité* says that three more lamps have lately been erected in the Boulevard Montmartre and three more in the Rue Drouot.

THE TELEPHONE IN CANADA.—Telephones have been erected in the Dominion Parliament Houses, and the new departmental offices are to be connected with the telephonic system of the city of Quebec.

AN ELECTRIC LIGHT IN EGYPT.—The railway station at Ismaila was illuminated the other day by the electric light, at the cost of the railway company. The Viceroy is said to have expressed great satisfaction with the result.

ELECTRIC LIGHT AT THE POST OFFICE.—We understand that the Brush light continues to give satisfaction in the circulation department; in the telegraph instrument room the Brockie light is said not to have been so successful.

THE TELEPHONE IN BERLIN.—The telephones erected in connection with several of the fire stations of this city have given such satisfaction that it has been determined to extend the system to many of the more distantly situated stations.

THE TELEPHONE IN PARIS.—The messages over the Société Générale des Telephones lines during one week recently were 33,123. The week before that they were 26,000. The number of subscribers to the Société now amounts to 1,080.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this company during the week ended the 10th June, amounted to £2,122, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company.

FAURE'S SECONDARY BATTERY.—The *Operator* states that, speaking of this battery, Mr. Edison says it is an old invention, and that he himself, two years ago, patented and applied a method for using the Planté battery in connection with electric lighting.

ELECTRIC LIGHT AND THE CZAR'S YACHT.—News from Constantinople says that during the stay of the "Livadia" at Buyukderé, extraordinary precautions were taken to prevent her being approached. Amongst other things, electric lights were kept burning all night.

THE INTERNATIONAL ELECTRICAL EXHIBITION. — The United States has nominated Mr. Levi Morton, its minister in Paris, as Commissioner-General of the U.S. section at the Exhibition. The U.S. Consul-General will undertake the duties of acting commissioner.

TELEGRAPHS IN PARIS.—*La Lumière Electrique* says that the Minister of Posts and Telegraphs has authorised the use in telegraph offices of the *Polygraphe* for the transcription of messages sent by the Havas Agency to the papers. This will effect a saving of time of nearly half an hour.

ANOTHER ELECTRIC LIGHT COMPANY.—The Kawsmouth Electric Light Company, with a capital of 100,000 dollars, has been incorporated at Kansas City, Mo. It is working under franchises from the United States Electric Lighting Company (Maxim patents), and has introduced the light with success in Kansas City.

A TELEGRAPHERS' SOCIETY.—The Erie, U.S.A., telegraph clerks have resolved to form a society to protect their interests. They do not intend to have any head-quarters, but to divide into small bodies of, say, fifty members each, each body having an advising committee of three members, who will meet twice a year to exchange views on the welfare of the society.

PRICES.—The prices as quoted are:—For gutta percha, per lb., genuine, 4d. to 3s. 3d.; reboiled 3d. to 1s. 3d. For india rubber, fine Para 3s. 7d., negrohead 2s. 4d., central American 2s. to 2s. 6d., Assam and Pegu 1s. 3d. to 2s. 2d., other East Indian 1s. 9d. to 2s. 4d., Madagascar and Mozambique 1s. 6d. to 2s. 4d. The market is reported as dull for all kinds.

THE TELEPHONE IN LEICESTER.—The Corporation have lately connected their police stations by means of the Gower Bell telephone, rented from the Post Office. The wire and necessary apparatus have been erected under the supervision of Mr. G. N. Partridge, of Nottingham, Inspector of Postal Telegraphs for the North Midland District. The apparatus is said to work very well.

THE BRUSH LIGHT IN BOSTON, U.S.A.—A company has been organised in Boston to work the Brush electric light, which has already been set going in Scollay-square. Arrangements are already completed to furnish with electric lights the Tremont House, Young's Hotel, the Crawford House, and several drug stores. It is intended to keep the Scollay-square lights burning all night.

ELECTRIC LIGHT IN DUBLIN.—The Mansion House of this city has been lighted up by the Brush system. Six lamps were placed in the newly-erected supper room, and ten more were placed in the garden and in Dawson-street. The lamps were fed by a Robey engine. The Swan incandescent lamp has also been on exhibition, and is said to have been successful as far as light-giving power is concerned.

THE BIBLE BY TELEGRAPH.—The *Operator* says:—"The text of the New Testament was transmitted to Chicago on the evening of May 20. It consisted of 110,000 words, and was started on four wires at 5:30 p.m. At 6 p.m. eight wires were used; at 7:30 p.m. sixteen wires, and at 8:45 p.m. twenty wires. It was finished at 12:20 a.m. This is considered, in many respects, the greatest feat ever accomplished in telegraphy."

ELECTRICITY IN SHIPS' SIDES.—In the *Comptes Rendus*, No. 23, for the 6th of June, 1881, is a note by M. A. Ledieu, in which he studies the question of the currents of electricity generated in the sides of ships, in which the covering of iron is separated from the copper sheathing by a layer of wood, the latter being rendered conductive by reason of its humidity. M. Ledieu thinks that one application of this discovery might take the shape of an automatic fire alarm for vessels.

A DIRECTORY OF TELEPHONE EXCHANGE SUBSCRIBERS.—We have received a very well got up and neatly printed directory to the subscribers of the Bell Telephone Exchange in Philadelphia. The names are arranged alphabetically, followed by the address of the subscriber; opposite the name is the subscriber's number. The "Directory" also contains a few brief rules of procedure in using the telephone. We think that this list is worthy the imitation of telephone exchanges in this country.

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ELECTRIC LIGHT FOR THE ST. GOTHARD TUNNEL.—The question of lighting the St. Gothard Tunnel by electricity is, says *La Lumière Electrique*, being warmly discussed. Two systems are put forward. The one proposes to use the tubes of compressed air which traverse the tunnel, to enable forty groups of lamps of a capacity of about 1,200 standard candles to be kept alight; the other system embraces the use of a headlight for the locomotive drawing the train, with reflectors to cast the light well ahead, and also on either side of the track.

THE LATE MAJOR PIERSON.—The premature death, at the age of forty-one, is announced of Major W. H. Pierson, of the Royal (Bengal) Engineers, a man of great and varied accomplishments, and closely associated with the telegraphic systems of India. He was one of the original constructors of the Indo-European telegraphs, and to his tact in political negotiations with the Persian Government the success of that important and difficult enterprise was greatly due. A correspondent of the *Standard* describes Major Pierson as one of the Admirable Crichtons of the British Army.

E.M.F. OF DIFFERENT GALVANIC ELEMENTS.—According to Thomsen's later measurements, the total development of heat by galvanic means in all parts of the Daniell cell amounts to 50,292 units of heat during the time in which one molecule of (Cu. SO_4) copper sulphate is reduced. A calculation of the value of the energy of the chemical processes in the cell gives 50,130 units. Hence, Thomsen concludes that the total chemical energy of a Daniell cell is converted into electricity, and the development of heat in the circuit is the equivalent of the chemical energy developed by the cell.

TELEGRAPH MATERIALS WANTED.—Tenders are invited for the supply of 2,775 tons galvanised annealed iron wire, 658,500 galvanised iron insulator brackets, 1,200,000 galvanised iron wood screws, 8,000 galvanised insulator bolts, 4,000 galvanised entretoises, 620,000 porcelain insulators, 300,000 galvanised malleable manchons fendus, 15,000 galvanised malleable iron bells, tools and tin solder, and 86,500 prepared telegraph posts. Particulars can be obtained from *La Ministère des Postes et Télégraphes*, Rue de Grenelle Saint Germain, 103, Paris, where tenders will be received up to the 21st June.

OVERHEAD WIRES.——In the House of Commons on Tuesday last Mr. Gladstone, answering Sir H. Tyler, stated explicitly that the responsibility of the overhead system of wires in towns rested entirely upon the local authorities. To prove how anxious the Post Office had been to remove this danger from the public thoroughfares, Mr. Fawcett added that whilst in 1877 there were 1,720 miles of overhouse wires belonging to the Department, within a radius of four miles from St. Martin's-le-Grand, and 3,350 miles of underground wires, there are now only 500 miles of overhouse wires, and the mileage of underground wires has increased to 4,388.

NEW METHOD FOR IMPROVING INDIA RUBBER.—A French inventor has patented a method of improving india rubber and gutta percha by the addition of a distillate of birch bark. By distilling the outer layers of the bark he obtains a dense black gummy matter, which possesses the properties of ordinary gutta percha, with the additional quality of resisting both the action of air and the strongest corrosive acids. He claims also that by adding a small proportion of the birch bark gum to gutta percha or to india rubber (one-twentieth part will suffice), the durability of the rubber or the gutta percha will be greatly increased, the new mixture not being acted upon by the air or by acids.

ELECTRIFIED PAPER.—"We recently received a cargo of *Scientific American* paper," says that journal, "that was so charged with electricity that the sheets would not separate without tearing, and we could not run them through the press. We were compelled to return the entire consignment to the maker, as its use was impracticable. We believe that printers are more troubled with electricity upon their papers and presses nowadays than formerly. Perhaps it is due in some measure to the more common practice of running the sheets through the press in a dry condition. On the other hand, may not the rapidly-increasing local uses of batteries and electric machines for telegraphs, telephones, lights, &c., yield such a superabundance of the mysterious element as to show itself in the press rooms?"

INCANDESCENT LAMPS IN SHIPS.—The *Scientific American* says that the first attempt to light the saloons of an ocean steamer by an electric lamp on the incandescent principle was made on board the "Columbia" on her trip from New York to Oregon, round Cape Horn, about a year ago, when she was lighted up by the Edison lamp. Our contemporary is, however, good enough to say, referring to the late trial of the Swan lamp, on the Inman liner, "City of Richmond," that "This latter attempt appears to be the first use of incandescent electricity in lighting an Atlantic steamer. The system adopted on the 'City of Richmond' is similar to Mr. Edison's, and was set up experimentally at the risk and cost of the inventor, Mr. Swan, an English electrician, whose lamps have been fully described in this paper."

ELECTRIC LIGHT IN THE HOUSE OF COMMONS.—During the interval between the morning and evening sittings of the House of Commons on the 11th inst. the experiment was tried of illuminating the chamber by means of the Brush electric light. For this purpose twelve opaque cases to hold the carbons have been suspended from the glass roof, which conceals the gas burners at present in use; but, in any permanent arrangement, it may be presumed that some plan less objectionable on æsthetic grounds will be devised. A sixteen-light machine has been provided, which will be worked by an engine placed in the basement. For illuminating the space under the galleries the Swan electric light will be utilised. Various opinions were, of course, entertained with regard to the results; but there was a general agreement that the experiment was sufficiently promising to justify its repetition.

ELECTRIC LIGHT IN MINES.—The experiments with the Swan lamp at the Pleasley collieries, near Mansfield, in Nottinghamshire, took place last week before the Royal Commissioners on Accidents in Mines and a number of electricians and scientific men. The pits are about 1,000 feet deep, and the workings are very extensive. In the present instance, however, the light was applied to three workings only, at a distance of about one-third of a mile from the bottom of the pits. The main wires were taken down the upcast shaft and connected at the bottom of the pit with cables, which were carried through the air passages till they arrived at the main levels. They were then taken along these main levels, and from them branch cables were carried up "gates" or side passages to the face of the actual workings. Here they were continued by insulated wires upon which the lamps were placed, and which were of sufficient length to reach to the extreme limits of the face of the coal that was being worked. Further details of these experiments will be given in our next issue.

AN ILLUMINATING APPARATUS FOR SURGERY.—At the Congress of German Surgeons, lately held in Berlin, Dr.

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Michael of Hamburg exhibited an apparatus he used for the purpose of illumination without the aid of lenses or reflectors. It consists of a glass globe exhausted of air, and containing phosphorescent substances in powder. These substances are made luminous by means of an aluminium electrode, which is brought into contact by means of a hard rubber-handle, with a Ruhmkorff induction machine. The light can be regulated according to the strength of the inductor; with a weak apparatus sufficient light is produced to enable small print to be read when held near the eye. In its present form the instrument, which Dr. Michael terms the psychrophor (cold light), is regarded by him as suitable for illumination in operations on the abdominal cavity and vagina, when the parts are not accessible to daylight. He hopes also to be able to make it available for cavities with narrow orifices.—*British Medical Journal.*

The Telephone in Philadelphia.—A committee of the Philadelphia City Councils has made an ordinance granting privileges to the Bell Telephone Company, for erecting poles and stringing wires, under which that company will put up 2,000 miles of wire in the city. The company must, however, file bonds agreeing not to charge more than the rates set forth in the classes following:—Class No. 1 includes dwellings throughout the city, the price per annum, with two or more on one wire, shall not exceed the sum of 40 dollars, and where any of this class desire the exclusive use of one wire, the price shall not exceed that charged in Class No. 2. Class No. 2 includes all business men, firms, and corporations with two on one wire, the price per annum to be charged for the first mile shall not exceed 75 dollars, and for any distance greater than one mile an additional sum not exceeding 30 per cent. per mile may be charged. Class No. 3 includes all business men, firms, and corporations having the exclusive use of one wire, the price to be charged for the first mile shall not exceed 100 dollars and for any distance greater than one mile an additional sum, not exceeding 30 per cent. per mile shall be charged; and provided that in cases with an average of fifteen calls per day or more on a wire, special contracts may be made.

Gas *v.* Electricity in Newcastle.—The following is extracted from the report of the Borough Analyst to the Town Council, with reference to the illuminating power of the Swan lamp and the lights supplied by the gas company in Mosley-street and Grey-street, Newcastle. He says:—"Ordinary street gas light in good order, 12 candles illuminating power; large single burner lamp on the south side of Mosley-street, 20 candles; Bray's three-light hexagonal lamp at the corner of Mosley and Dean-streets, 80; Bray's three-light globular lamp at the corner of Mosley and Grey-streets, 97; and group of eight of Swan's electric lamps at the corner of Grey-street and Mosley-street, 120 candles illuminating power. It was difficult to measure very exactly the illuminating power of lights such as these, but he was of opinion that the above results very closely represented the actual and relative amount of light thrown on to the streets by the various lights used. On account of the manner of grouping the eight small electric lamps the light shining in any one direction on the streets from some of the lamps of the electric light was to some extent intercepted by the stems and globes of the other small lamps of the group, so that the light given by each small lamp could not be deduced from the total light thrown in one direction by the group given in the above results."

Electric Light for Wigan.—Mr. J. G. Hawkins, Gas Engineer to the Wigan Corporation, makes the following report on the electric light:—"With the present appliances it is found that the electric light costs about double that of gas, but if light for light is taken as the basis, then the electric light is by far the cheaper of the two—in fact, I am certain that as the electric light becomes more generally used, it will be found that, with proper centres of distribution, it can be supplied at an exceedingly low figure compared with gas. It must not be supposed that in saying this I am inclined to think that illumination by gas will be entirely superseded by electricity, for that is not so. Gas will, in my opinion, hold its own against any other form of lighting for certain purposes. It is only to street lighting, the illumination of large spaces, large shops, and large buildings that the electric light can look forward with any amount of hope. Private lighting by gas will, in my opinion, never be seriously affected by the electric light, because there are so many intricacies continually cropping up against which gas has to withstand, and which it does successfully, but any single one of them might, where the electric light is employed, be the means of putting a whole district in total darkness. It is only where the whole thing, from one extreme to the other, can be brought under the personal control of the companies that the electric light can ever hope for success. Though not requested to make any recommendation with regard to carrying out experiments in Wigan, still I feel bound to say the success that has so far attended the use of the electric light induces me to suggest that the gas committee should at least try one of the systems on a scale just sufficiently large to enable them to satisfy themselves as to its cost and applicability to lighting the principal thoroughfares in Wigan."

"Ourselves as Others See Us."—From amongst the remarks made by the President of the West of Scotland Association of Gas Managers, we extract the following:—"Occasionally we may hear the triumphant note of some imaginative electrician who has rather rashly jumped to the conclusion that he has discovered the philosopher's stone, and henceforth there is to be no further use for gas, except it may be to supply motive power for dynamo-electric machines. 'Familiarity,' it is said, 'breeds contempt,' and in the matter of public lighting there is now perhaps too great an inclination to sneer at the electric light and the progress it has been making. That it has progressed in recent years no one will be foolhardy enough to deny; but that it has taken the position claimed for it by its admirers I am quite prepared to dispute. A parallel has been attempted to be drawn between the early history of gas and the present and too greatly overwritten history of electric lighting, and an endeavour has been made to show that the opposition to gas was much the same at the beginning of the century as the opposition to electric lighting is towards its close. But it is entirely left out of sight that from the outset of gas lighting the material to be used as an illuminant could be stored in quantities, and the supply drawn as required, and further that it could be sub-divided into as many minute points as the exigencies of the case demanded. Wherein have we any parallel in electric lightning? It has been found impossible to subdivide the light except with the loss of great power, and that where such subdivision occurs, the light, leaving aside its novelty, is no better than that supplied cheaply and conveniently by gas. Superiority is claimed for the new light where immense spaces require to be illuminated, or where there is a desire to concentrate a powerful body of light upon a particular spot, and perhaps there are some grounds to be urged in favour of this contention."

Threatened Strike of the Telegraph Clerks.—Largely attended meetings of telegraph clerks were held in

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London, Belfast, and other places on Saturday last to take into consideration the answers of Mr. Fawcett in the House of Commons with reference to compulsory overtime, and the legal status of telegraph clerks. The meetings were unanimous in their disapproval of these answers, and cases were cited in proof that overtime was exacted very harshly and excessively. Resolutions were finally passed suggesting that the representatives of the clerks should convene together at the earliest possible date, and the meetings enthusiastically resolved to abide by whatever decision should then be arrived at. A week's cessation from work, or a longer period if necessary, was suggested, and was supported by every member present. A further resolution pledged the female staff present at the meeting to uphold the male staff in any action found necessary to obtain their just rights, and decided that no female clerk should perform more than eight hours duty daily, or be required to work any overtime. According to the *Daily News* the claims put forward by the clerks are as follows:—Scales of pay same as for other Government offices where the Playfair scheme applies; payment of overtime for work on Sundays, Good Fridays, and Christmas Days; overtime to be paid at the rate of one forty-second part of the weekly salary for each hour; the time occupied in going to and from home for the purpose of doing overtime to be paid for; a month's annual leave for clerks receiving £2 a week and upwards, and three weeks for clerks receiving less than that sum; lastly, the allowance for special duties away from town to be increased to sixpence an hour. According to the latest accounts the clerks have decided to refuse to work overtime after the 27th inst. An official circular issued on Wednesday states that overtime must of necessity be compulsory, in order to dispose of the fluctuating business of a telegraph office, but that every care is taken to arrange overtime so as to bear with as little inconvenience as possible upon individual members. It was stated in the House of Commons in 1871 that overtime was not compulsory. There is great excitement among the clerks on account of this circular.

The Grievances of Telegraph Clerks.—In the House of Commons on Friday, the 10th inst., Mr. Fawcett replied to questions put to him by Mr. S. Macliver and Mr. Labouchere with reference to the status of the postal telegraph clerks, and their obligation to perform overtime. Mr. Fawcett said:—"So far as I am aware no privileges to which the telegraphists are entitled have been withheld from them, nor is it intended that any privileges to which they are entitled should, in future, be withheld from them. In order to prevent a misapprehension which may arise from the reference contained in the hon. member's question to an answer given by the Attorney-General some time since, I think it is well to say that I have the authority of my hon. and learned friend the Attorney-General to state that in the answer to which reference has been made, he never for one moment intended to convey the idea that the telegraphists were entitled to any legal rights which they have not enjoyed." With regard to the overtime question, Mr. Fawcett went on to say:—"I think it will be obvious to the House that in the Telegraph Service there must occasionally be an exceptional pressure of work, when, for instance, unusually long Parliamentary debates or important political demonstrations have to be reported. Unless a staff were maintained which, for ordinary purposes, would be redundant, it is evident that when there is this pressure of work it can only be got through by some of the telegraphists being employed on overtime. It often happens that a sufficient number of volunteers are found for the overtime work which is required; but when this is not the case, the course which is adopted at the Central Office is to select by ballot the number required to work overtime. In reply to a question addressed to me on a former occasion, I stated that I was very desirous that the amount of overtime work should be no greater than is rendered necessary by the requirements of the service, and in order to effect this, among other objects, I have already submitted certain proposals to the Treasury. With regard to the latter part of the question, I am sure my hon. friend will see that an inquiry involving considerations of legal status would be most fittingly addressed to the law officers of the Crown." In reply to a further question, Lord F. Cavendish stated that the scheme which had been approved by the Treasury would be issued shortly, and that its provisions would take effect from April last.

The Faure Battery and "The Times."—A Caution.—"A prospectus is now being circulated in this country of the ordinary shares of a company called 'La Force et la Lumière,' stated to be a joint-stock company duly incorporated in Belgium, with limited liability, the object of which is to work the patents taken out in various countries for the processes of Mons. Camille Faure and Mons. Emile Regnier, whereby electricity is capable of being stored and made applicable to every practicable purpose.' The inventions thus referred to, as we have had occasion to notice, are of great scientific and practical interest; but the question of investment is a different matter, and as the present issue is of £10 shares at par, to bear 5 per cent. interest only, with no other privilege in addition but that of 'a preferential right to an allotment at par of shares in affiliated companies to be hereafter created,' we think it may be useful to point out that, whatever the scientific and practical interest of the subject may be, the public ought also to consider carefully what the conditions of this investment are. The issue is altogether of £240,000, which appears a large sum for developing an invention as yet in a comparatively experimental stage, and, as we have said, the shareholders are not to share fully in the profits, but are only to get 5 per cent., with a preferential right to allotment at par in affiliated companies. This preferential right may become profitable, but in no other shape, as far as we can see, will shareholders profit. They will be entitled to have their money back before the founders get anything, but if the invention is a great success it is the founders who will mostly gain. Of course, the question is only one of terms between the holders of a patent and the capitalists who are to find the money for working it; but the terms should be clearly understood. We may also call attention to the fact that, while the company is a Belgian one, its offices are stated to be in Paris, and its council of administration consists of 'Monsieur S. Philippart, Monsieur S. Philippart Fils, Major F. J. R.-Seaver, F.R.S.E.' Everything in such a matter, we need hardly say, as far as the security of the investment is concerned, turns upon the administration, whatever the value of the business or invention may be. The prospectus also states that Sir William Thomson is the consulting engineer of the company, and quotes his opinion as to the scientific merits of the invention; but investors, we assume, are not entitled to infer from this that Sir William Thomson is identified with the company in any way or is bound to do more than give them advice when he is consulted."—Mr. Seaver in the issue of *The Times* for Thursday, 16th June, writes an explanatory letter concerning this criticism. In our estimation, however, the letter is a still stronger condemnation of the method of action taken by Mr. Seaver to dispose of either public or private shares than any comment could be.

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HEAT THEORY OF THE PRODUCTION OF ELECTRICITY.*

BY J. L. HOORWEG.

(Continuation of *Wiedemann's Annalen Ann.* 9, p. 590, 1880.†)

Sec. 12. In the 10th paragraph of my former paper I have expressed the opinion that "if, in a closed chain of different materials, the sum of the electric differences is not zero, then a galvanic current is produced." Now I will proceed to examine in which combinations this is the case.

As regards electricity, one divides the bodies into insulators and conductors; the latter are again separated into two different groups—those which conduct metallically and those which conduct electrolytically.

We know now the conducting power of glass,‡ of gutta percha;§ alcohol, ether, and benzoline;‖ and of paraffin, wax, ebonite, shell-lac,¶ &c.; and the difference between conductors and non-conductors is, of course, only relative.

Again, the division of bodies into such as conduct metallically and such as conduct electrolytically is not a natural one for the conduction of selenium, tellurium, and phosphorus is different from that of iron and copper. In addition, the combination of two such distinct ideas as those of electrolysis and of conduction ought to be rejected.**

There are only two ways in which electric influence can be communicated—by conduction and by induction, which are distinct from one another, but analogous in heat with conduction and radiation. For heat bodies may be divided into two classes, the one possessing great diathermancy but small conducting power, the second having small diathermancy but a high conducting power. So for electricity there are two distinct properties called by Maxwell specific inductive capacity and specific resistance, called k and r, and when in a body one is high the other is low.

Bodies can be arranged in one series, beginning with air, having a low specific inductive capacity and a high specific resistance, and ending with the well-conducting metals.†† At the top of this list stand the insulators or dielectrics (k = a few units, r = many billions), and at the bottom are the metals ($k = \infty$, r = a few millionths). Not quite in the middle come the liquids which are used in galvanic cells (k = a thousand millions, r = several units).‡‡

The latter are linked to the metals by the metalloids, phosphorus, selenium, carbon, and sulphur, whilst the connection with the insulators is formed by the minerals, such as mica, arragonite, &c., and the so-called half conductors.

Between selenium, graphite, &c., on the one hand, and the metals on the other, there is a wide gap, for while the resistance of all other bodies diminishes with increase of temperature, the resistance of the metals is increased. Heating the substances at the two ends of the series makes them approach the centre.§§ Perhaps there may be a high temperature, at which the resistance of all bodies is the same. If, however, the assertion of Lenz is true|||| that there is a turning point in the law of increase of resistance of the metals, this, of course, could never happen.¶¶ However this may be, I think it will be well to divide the series into two groups:—

1. Those substances of which the conducting power increases with the temperature.

2. Those, on the contrary, of which the conducting power diminishes as the temperature increases.

The first group I call the dielectric, the second the adielectric. To this nomenclature there is this objection, that the dielectric property of some members, such as water ether, carbon, &c., of the first group is not well known, and, indeed, it would be difficult to determine it with certainty on account of electrolytic polarisation. I can only remind you of the relationship worked out by Maxwell between the dielectric and diathermic properties in the opposed currents, which Sabine* observed in selenium, and of the experiments of Varley and Herwig for the determination of the dielectric constant of acidulated water.

Without previously entering into a consideration of the duration of the currents, the following I give as the answer to the question asked at the beginning. "A current is always produced if at least one link of the closed chain belongs to the dielectric of the first class." To substantiate this opinion I have made a series of experiments with dielectric materials, using a Wiedemann galvanometer and a Thomson quadrant electrometer. The galvanometer showed with a current of one microfarad a deflection of 242 scale divisions. In the electrometer a deflection of 20 centimetres was produced with the electromotive force of one Daniell cell.

The combination to be examined could be united either with the galvanometer or with the electrometer. The metal plates *a*, *b*, Plate II., Fig. 3 (zinc and copper) were united above with glass and silk, and at the bottom were separated by a distance of 1·3 millimetre. Neither with the glass alone, nor when the ends of the plate were touched at the bottom did there appear a perceptible current. By means of the silk thread *c*, the two plates hung freely in the liquid dielectric, which was heated in a porcelain evaporating dish, *d*. After a uniform and constant temperature had been obtained, the deflections on both instruments were quickly observed one after another. Then the flame was removed, and as the temperature fell the current was measured until the liquid solidified. Generally I could perceive the current even after solidifaction, and when at length the galvanometer was unable to measure the current, the electrometer plainly showed the potential difference. With infusible powdery materials I put a thin layer of the powder between two pieces of cardboard and pressed the whole together in a screw-press. With zinc sulphate and similar bodies I covered one of the plates with a layer of finely-powdered crystals and warmed it, when the plate covered itself with an adhering crust, upon which the second metal plate was pressed.

The following results were obtained†:—

1. Zinc. Stearic Acid. Copper. Copper + Pole.

Temp.	*Electromotive Force.*	*Current.*	*Resistance.*
163°C	0·855 Volts	17 Microfarads	1 Megohm

The copper was being slowly dissolved in the hot acid. After cooling no perceptible deflection.

2. Zinc. Paraffin. Copper. Copper + Pole.

Temp.	*Electromotive Force.*	*Current.*	*Resistance.*
165°C	0·36 Volts	0·02 Microfarad	18 Megohms
50°C	0·17	0·002	85

3. Zinc. Spermaceti. Copper. Copper + Pole.

140°C	0·783	0·123	6·4
47°C	0·55	0·025	22

4. Zinc. Rape Oil. Copper. Copper + Pole.

130°C	0·886	0·54	1·6
45°C	0·746	0·02	73·3

5. Zinc. Shellac. Copper. Copper + Pole.

150°C	0·66	0·3	2·2
70°C	0·39	0·016	24·4

6. Zinc. Wax. Copper. Copper + Pole.

155°C	0·55	0·18	3
52°C	0·034	0·004	8·5

7. Zinc. Sulphur. Copper. Copper + Pole.

145°C	0·073	0·002	36·5
35°C	0·073	0·0015	48

The copper is much acted on, and the current diminishes very rapidly.

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* *Annalen de Physik und Chemie.* Bund XI., pp. 133—155.

† I regret very much that when writing my first treatise I was not then well acquainted with the beautiful experiments of *Hankel*, nor did I know of those of *Perry and Ayrton*, which surpass mine in delicacy and exactness, whilst they lend additional confirmation to the value of my theory.

‡ *Beetz, Pogg. Ann.* 92, p. 462, 1854.

§ *Jenkins, Electricity and Magn.*, p. 252, 1873.

‖ *Said Effendi, Comp. Rend.* 68, 1869.—*Gladstone and Tribe, Proc. Roy. Soc.* 26, 1877.—*Domalip Wien Ber.* 2 *Abth* 7,620, 1875.

¶ *Ayrton and Perry, Proc. Roy. Soc.* 27, 1878.

** As little can we draw a sharp distinction between solids and liquids, for the liquid mercury has properties in common with solid copper, ice with water, copper sulphate crystals with a solution of this salt.—(*Gross*, Berlin Monthly Periodical, 1877).

†† Perhaps this electric series is the same as the thermal.

‡‡ *Jenkin's Electricity and Magnetism*, p. 249, 1873.

§§ Müller, *Pogg. Ann.* 103, p. 176, 1858.

|||| Lenz, *Pogg. Ann.* 34, p. 418, 1835.

¶¶ Tellurium, however, seems to approach the metals (*Wiedemann's Galvanismus*, p. 297, 1872).

* Sabine, *Phil. Mag.* 5 (5) 1878. A similar but weak opposing current I have observed in carbon.

† My standards were one Daniell cell and one Siemens unit of resistance; and the ratio I have employed is

1 Volt = 0·975 Daniell. 1 Megohm = $1·03 \times 10^6$ Siemens.

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8. Zinc. Chalk. Copper. Copper + Pole.

Temp.	Electromotive Force.	Current.	Resistance.
22°C	... 0·113 Volts	... 0·053 Microfarads	... 2·1 Megohms

The current tolerably constant.

9. Zinc. Glassy Lead Chloride. Copper. Copper + Pole.

20°C ... 0·55 ... 5·5 ... 0·1

The galvanometer deflection diminishes pretty quickly.

10. Zinc. Dry Zinc Sulphate. Copper. Copper + Pole.

20°C ... 0·7 ... 7 ... 0·1

The current falls off.

11. Zinc. Dry Zinc Sulphate. Powdered Copper Sulphate. Copper.

20°C ... 0·82 ... 1·62 ... 0·5

Current very constant, and rather increases than decreases in ten minutes. With an ordinary multiplier a deflection of 2° is produced by this cell.

12. Zinc. Carbon.* Copper. Copper + Pole.

(A very weak current of about 0·002 volts†).

If these experiments be compared with those of Jäger‡, of Bohnanberger§, and Münch, made with dry cells, a verification of my experiments I hope will be found.‖

That two dielectric bodies may exist together in a chain is shown by the experiments of Sabine¶ with selenium—water-platinum. To this portion of the subject also belongs two fluid galvanic cells.

Sec. 13. From the above results an important conclusion can be drawn when it be considered that the electromotive force of the different combinations was never exactly the same as the contact electromotive force of zinc-copper (0·8 Daniell), and this conclusion is that:—

At the contacts of metals with insulators, as well as at the separate contacts of dielectrics one with another, there is a constant and permanent difference of potential.

(TO BE CONTINUED.)

THE THEORY OF ALTERNATING CURRENT MACHINES.

Alternating current machines are generally constructed on the type first introduced by Mr. Clarke, and consist essentially of electro-magnets, producing a magnetic field in which the rotation of a series of bobbins induces a succession of short electric currents, alternating in direction. The electro-magnets are usually excited by a continuous current from a separate or combined machine called the *excitor*.

The theory of these elementary machines is very simple; for any displacement of the armature or induced system with respect to the inducing system, the electromotive force is proportional to the number of lines of force traversed by the induced circuit. For example, in the Clarke machine, let one of the bobbins be opposite the pole A, and let S be the total surface comprised by the spires, and H the mean intensity of the field in the region occupied by the bobbin; then the total flow of force embraced by the bobbin is S H. When the same bobbin is in front of the pole B it becomes — S H, the values of H at A and at B being equal and of contrary name. When the bobbin passes from A to B the total variation of the flow or "magnetic flux" will be 2 S H. The electromotive force corresponding to this displacement will have for expression the same product, and, if R is the resistance of the circuit, the quantity put in motion is

$$\frac{2SH}{R}.$$

At each instant the current is proportional to the variation of the flux, or number of stream lines crossed; it is a maximum between the two poles, where the variation is the most rapid; it is *nil* at A and at B, where for a moment the variation is *nil*. In the second half of the path from B to A the same succession is produced, but in a contrary direction.

If this elementary theory were complete, the law of the intensity at each instant would be Ohm's law, and the change of current direction would take place exactly opposite the poles. But recent experiments by M. Joubert demonstrate that it is not so. These researches have been made chiefly with a Siemens alternating current machine. In it the intensity of the field and that of the current at each instant follow exactly the law of the sinus, but the two sinusoids present with respect to each other a difference of phase variable with the speed of rotation and the resistance of the circuit.

The most important question from a practical point of view is the law of variation of mean intensity with resistance. This mean intensity is the square root of the mean of the squares of the intensities at each instant.

Numerous experiments made by M. Joubert with resistances varying from a few to 100 ohms at speeds running from 100 to 1,200 turns per minute, have shown that this mean intensity satisfies exactly the relation

$$I = \frac{e}{(R^2 + a^2)^{\frac{1}{2}}},$$

where R is the total resistance of the circuit, a a constant which depends only on the speed and is proportional to it, and e another constant equal to the quotent by $\sqrt{2}$ of the maximum electromotive force of the machine with open circuit. This electromotive force was measured by connecting one pole of the open circuit to earth through an interruptor or key, and the other to the plate of a Thomson portable electrometer. The simplicity of this result and the perfect concordance of the formula with the experiments seems to prove the formula not merely an empirical one. M. Joubert has, therefore, sought to justify it by theory.

Suppose the machine in a state of uniform motion. Let, at any given instant, E be the value of the electromotive force due to a primitive field and i the intensity of the current. The electro-dynamic work during the time dt is equal to $E \cdot i\,dt$, and this work, if the current does not produce any mechanical work in the circuit, chemical or luminous ought to show itself entirely in developing heat, $i^2 R\,dt$, and in the work of the inverse electromotive forces which the reactions of different parts of the machines give rise to. Experiment shows that the reactions upon the inducing electro-magnets are negligable, and we have only to consider those of the induced circuit on itself. If we represent by U the flux of force emanating from the induced circuit when it is traversed by the unit current—that is to say, the co-efficient of *self-induction*—and by di the variation of the intensity during the time dt, the variation of the flux of force, and consequently the electromotive force will, during the same time, be $U\,di$, and the corresponding work will have for value $U\,i\,di$. We will, therefore, have by the principle of the conservation of energy,

$$E\,i\,dt = i^2 R\,dt + U\,i\frac{di}{dt}dt,$$

where, in dividing by i and by dt,

$$E = iR + U\frac{di}{dt}, \quad \ldots\ldots\ldots \quad (2)$$

an equation in which we must take $E = E_0 \sin. 2\pi\frac{t}{T}$, T being the duration of the period.

In putting

$$\tan. 2\pi\phi = \frac{2\pi}{T}\cdot\frac{U}{R}$$

the integral of the equation (2) can be expressed.

$$i = \frac{E_0}{\left(R^2 + \frac{4\pi^2 U^2}{T^2}\right)^{\frac{1}{2}}} \sin. 2\pi\left(\frac{t}{T} - \phi\right) = A \sin. 2\pi\left(\frac{t}{T} - \phi\right).$$

The constant being determined by the condition that $t = \phi T$ when the intensity is *nil*. The intensity of the current at each instant is then represented by a sinusoid, of which A is the amplitude, and ϕ is the phase.

* A 4 centimetre long rod of coke carbon.

† I have later measured the electromotive force of all combinations with a Lippmann capillary electrometer, and the results so obtained agreed fairly well with those given above.

‡ Jäger Gilbert, *Ann.* 49, p. 47 — 50, p. 214. 1815.

§ Bohnanberger Gilb., *Ann.* 53, p. 346, 1816. Münch, *Pogg. Ann.* 43, p. 193. 1838.

‖ Later on I found the measurements of electromotive force and specific resistance made by Ayrton and Perry (*Proceedings Royal Society*, p. 28, 1878), of paraffin wax, shellac, ebonite, gutta percha, and mica, and the experiments of Thomson's (*Proceedings Royal Society*), 23, p. 463, 1875) with glass. With the combination platinum—water without air—gold (gold + pole) I found a current lasting a short time, which reappeared after each opening and closing of the circuit.

¶ Sabine, *Phil. Mag.* 5 (5), 1878.

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We deduce from that for the mean intensity,

$$I = \frac{\frac{E_0}{\sqrt{2}}}{\left(R^2 + \frac{4\pi^2 U^2}{T^2}\right)^{\frac{1}{2}}}, \quad \ldots\ldots (4)$$

a formula coinciding with that given by experiment. Experiment shows that E_0 varies in proportion to the intensity of the field and to the speed. If we call e_0 the maximum value of the electromotive force when, for the given intensity of the field, the speed is about a turn per second, and when there are n periods per turn,

$$E_0 = \frac{e_0}{n\,T},$$

and the formula of intensity becomes

$$I = \frac{e_0}{n\sqrt{2}\,(R^2 T^2 + 4\pi^2 U^2)^{\frac{1}{2}}}. \quad \ldots\ldots (4)$$

The discussion of this formula leads to some interesting remarks. The electro-dynamic total of the machine has for its expression

$$W = R\,I^2 = \frac{R\,e_0^2}{2\,n^2\,(R^2 T^2 + 4\pi^2 U^2)}.$$

This expression tends towards zero when the resistance increases indefinitely, and becomes *nil* when the circuit is open. Experiment shows, in fact, that in this case we have no other work to overcome than the passive resistances. But, contrary to what passes in a battery, the maximum does not correspond to a *nil* external resistance. The work increases when the resistance augments and reaches a maximum which corresponds to the equation

$$R = a = \frac{2\pi U}{T}.$$

The equation of the phase then gives

$$\tan. 2\pi\phi = 1, \quad \text{or} \quad \phi\, m = \tfrac{1}{8}.$$

The retardation is equal to a fourth of the interval which separates two consecutive poles of contrary sign. For $R = \infty$, this retardation is *nil*; when R or T decreases indefinitely ϕ tends towards the value $\frac{1}{4}$. In other words the retardation tends to become equal to half the interval which separates the two consecutive poles.

Equation 4 shows that the intensity does not increase indefinitely with the speed, but that it tends towards a limited value:

$$I_0 = \frac{e_0}{n\sqrt{2}\,.\,2\pi U}.$$

What corresponds to the maximum work is

$$I\,m = \frac{e_0}{4\,n\,\pi\,U},$$

hence

$$\frac{I\,m}{I_0} = \frac{1}{\sqrt{2}}.$$

We see, then, that if R T is made equal to a constant I is constant; hence we can always, whatever be the resistance of the circuit, with a convenient speed obtain a given intensity inferior to the maximum. In particular, we can always obtain the intensity which corresponds to the maximum of work.

The intensity of the field and the speed are two elements, so to say, external to the machine; there are three others, which belong to its constitution of the electromotive force, the internal resistance, and the coefficient of self-induction.

Experiment shows, as we have already said, that the electromotive force is rigorously proportional to the speed and the intensity of the field; and it should be added that in this class of machine the electromotive force is very high. The Siemens machine, for example, employed by M. Joubert, at a normal speed of 720 turns, has an electromotive force of 500 volts at a maximum, and a mean value of 350 volts. The exciting current being 20 webers in strength, at a speed of 1,500 turns, with a 30 weber exciting current, the mean electromotive force is 1,000 volts and the maximum 1,500 volts.

This fact explains how alternating current machines are particularly suitable for the division of the electric light. Most continuous current machines have only a relatively feeble electromotive force; the ordinary workshop of Gramme, for instance, having an electromotive force of about 80 volts.

Relatively to the two other constants, let us consider two extreme cases, those in which each term of the denominator is negligable before the other. If the term $2\pi U$ is negligable before R T, the machine almost follows Ohm's law; it behaves like a battery in which we can vary the electromotive force at will without changing the internal resistance. This is the state toward which machines tend when the external resistance increases indefinitely.

Let us suppose, on the contrary, that the term R T is negligable before $2\pi U$ within certain limits, the intensity would be little influenced by variations of R. This is the ordinary condition of machines. The speed is always very great, and the external resistance middling. Under these conditions the internal resistance of the machine has only a secondary influence.

The two constants e_0 and U are the variables characteristic of this class of machine. In general, one cannot modify one without modifying the other at the same time; but the ratio of these two quantities may vary in an arbitrary manner. When the term $2\pi U$ preponderates in the denominator, the variations of U have an enormous influence on the intensity.

The formula also furnishes an answer, in each particular case, to practical questions on the grouping of the bobbins, and the length and diameter of the wires on each of them.

PROFESSOR MINCHIN'S ABSOLUTE SINE ELECTROMETER.

This is an electrometer on the attracted disc principle, for the purpose of measuring electromotive force in absolute electrostatic units. The disc is a square of aluminium, each side of which is three centimetres long, its weight being ·2568 grammes. It is suspended vertically by means of two Wollaston platinum wires, each about seven inches long, which are connected with a guard plate at its upper edge, this plate and the continuous plate being suspended like a compound pendulum from a horizontal axis. The disc, when flush with its guard plate, rests against the the tops of four fine screws, and its distance is then ½mm. from the continuous plate. The guard and continuous plate are each about a foot square, and are connected by four ivory axes near their corners, these axes being fixed in ebonite pieces let into each plate. Mica washers, each ½mm. thick, are placed on the axes between the two plates, and serve to maintain the distance between the plates. The system of two plates can be moved round their common horizontal axis by means of a micrometer screw, whose pitch is $\frac{1}{60}$ inch, and whose head is divided into 1,000 equal parts, the point of this screw working against the lower part of the guard plate at a distance of 15 inches below the axis of suspension. To take a reading the disc is adjusted in a vertical plane (with the two plates, of course); but this adjustment need not be very accurate. The system is then tilted arbitrarily round the axis by means of the micrometer screw; the + pole of the battery whose E.M.F. is to be measured is connected with the continuous plate, and the — pole with the guard and disc. The screw is brought back (or moved forward) until the disc is just drawn off the four screw points on which it rests, this motion being easily observed through a microscope at the back of the disc attached permanently to the guard plate. A few cells are added to, or taken from, the battery and a new reading taken. If n is the number of cells in the first reading, and m in the second, E the electromotive force of one cell, it is easily proved that

$$(m^2 - n^2)\,E^2 = k\,\Delta,$$

where k is a known constant and Δ the difference of the circular measures of the two angles of deflection from the vertical, this being given by the motion of the screw. Since in the limiting position of equilibrium of the disc the electrical attraction is proportional to the *sine* of the angular deflection from the vertical, the instrument is called the *Absolute Sine Electrometer*. Its sensitiveness has been found to be exceedingly great, a motion of the screw through 27,230 revolutions giving in one instance a motion of the disc, while a motion through 27,335 revolutions just failed to do so; it is also very sensitive to a small change in the number of cells employed. Experiments are in progress. The instrument has been constructed by Mr. Groves, of Bolsover-street.

ELECTRIC RAILROADS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Will any of your readers interested in the promotion of electric railroads and the like inform me what is to be gained by investing in an electrical generator when the only power available for driving it is a steam engine? For example, a stationary engine pulls trucks of gravel up a steep incline from the pit by means of a rope. Would my steam engine do more work, or would it consume less coal, if I added a dynamo machine, &c., to my plant? I have been told that the engines employed for driving the generators on the electric railways could very easily —more easily—pull the carriages by means of a stout rope. Directly I heard this I buttoned up my pockets, waiting information.—Yours, &c.,

INQUIRER.

1st June, 1881.

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THE ELECTRICIAN.

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ELECTRICITY AND SURGERY.

Mr. Swan, in his now celebrated lecture to the Philosophical Society at Newcastle-on-Tyne on October 20, 1880, pointedly called attention to the question of storage of electricity. He referred to the secondary battery of M. Planté, and to a modification of that battery which he exhibited to his audience, as contributions towards the solution of the question. Since the time above mentioned other minds have considered the subject, and quite recently considerable excitement has been caused by letters to *The Times*, mentioning in high terms of praise the improvements M. Faure has made in secondary batteries. A battery constructed on the Faure principle is undergoing investigation in the hands of Sir W. Thomson, who has already, as our readers are aware by the letter we reprinted from *The Times* in our last issue, spoken of its utility in certain directions. In this letter Sir W. Thomson referred to the use of the battery in a surgical operation by Professor G. Buchanan, and the operation is more fully described by Dr. Buchanan in the current issue of the *British Medical Journal*. We have already (vol. vi., p. 323) explained the construction of this battery, but a brief description of that used by Dr. Buchanan may not be out of place. It consists of a cylindrical vessel of lead nine inches high by five inches in diameter, containing the lead plates coated with minium and sheathed in felt. When required for use the felt, which should always be kept moist, is wetted with dilute sulphuric acid, and the current is then taken off by electrodes attached to the lead plates.

Dr. Buchanan says:—"On June 3rd I removed a nævoid tumour from the tongue. The nævus was situated on the anterior half of the right side of the tongue of a young gentleman eleven years of age. It had been in existence for many years, but latterly it had frequently been scratched, and then bled freely. As the growth was very vascular and invaded the tongue almost to the middle line, I determined to remove it by the thermocautery. Having occasion to see Sir William Thomson the day before the operation, he offered me the use of a Faure battery, which had been sent from Paris only a few days before, and on which he was engaged in experimenting to test its value. He was so enamoured of its powers that he said, 'It is a witch.' And now it has the name of the 'Electrical Witch' at the University. In driving to my patient I called at Sir William's laboratory, and got with me a battery which can easily be carried in one hand, and without the least difficulty. After having put the patient under chloroform, I attached its poles to a platinum wire-écraseur, and removed the tumour without a drop of blood."

Whatever the value of the battery may prove to be in other directions, there can be no mistaking the evidence given by this operation. Hitherto the use of electricity in surgical operations has been more of a theoretical than of a practical character. Electricians will easily understand how a wire raised to white heat by a battery, under ordinary conditions, would fail to retain this exceedingly high temperature when brought into contact with the moist tissues of an animal body. The conducting power would be enormously increased, and the demands made upon the battery to keep the wire white hot would be proportionately increased. It seems, then, that the secondary battery solves a difficulty which has till now stopped the extensive use of electricity in such operations as that described by Professor Buchanan.

Another application of electricity was made by Professor Buchanan, by the advice of Sir W. Thomson, to the examination of parts of the body by means of Swan's lamp. This application is, of course, merely an imitation of the Trouvé "polyscope," or, as it is now termed by a German adapter, the "electro-endoscope." Swan's incandescent spiral of carbon filament enclosed in its glass bulb is only a large-sized electro-endoscope. Held by a handle of glass tubing its light can be directed to any part of the patient, and the heat it gives out can be readily borne by the skin of the patient without any danger of setting fire to the bedclothes. Tried on a man afflicted with a tumour in the scrotum having all the characteristics of a hydrocele, the lamp proved highly successful in showing the translucency of the tumourous growth. The man was compelled to keep a recumbent posture owing to a fracture of the thigh, and it would have been impossible to examine the tumour by candle or any other light except that of the incandescent globe. The experiment was made in the ward of the University Hospital, and the translucency was rendered visible to every student present.

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FURTHER CORRESPONDENCE TO "THE TIMES" ON ELECTRIC STORAGE, &c.

TO THE EDITOR OF THE TIMES.

SIR: Your leading article in *The Times* of yesterday on the storage of electricity alludes to my having spoken of Niagara as the natural and proper chief motor for the whole of the North American Continent. I value the allusion too much to let it pass without pointing out that the credit of originating the idea and teaching how it is to be practically realised by the electric transmisssion of energy is due to Mr. C. W. Siemens, who spoke first, I believe, on the subject in his presidential address to the Iron and Steel Institute in March, 1877. I myself spoke on the subject in support of Mr. Siemens's views at the Institution of Civil Engineers a year later. In May, 1879, in answer to questions put to me by the Select Committee of the House of Commons on electric lighting, I gave an estimate of the quantity of copper conductor that would be suitable for the economical transmission of power by electricity to any stated distance; and, taking Niagara as example, I pointed out that, under practically realisable conditions of intensity, a copper wire of half an inch diameter would suffice to take 26,250 horse-power from water wheels driven by the Fall, and (losing only 20 per cent on the way) to yield 21,000 horse-power at a distance of 300 British statute miles, the prime cost of the copper amounting to £60,000, or less than £3 per horse power actually yielded at the distant station.

I remain, Sir, your obedient servant,

WILLIAM THOMSON.

The University, Glasgow, June 9.

[In the second sentence of the third paragraph of Sir William Thomson's letter, published in *The Times* of June 8, for "its own laboratory battery," substitute "my own laboratory battery."]

TO THE EDITOR OF THE TIMES.

SIR: Although agreeing with every word of Sir William Thomson's letter in *The Times* of to-day, and entirely sympathising with his enthusiasm as regards the marvellous box of electricity, still I feel that it would have been desirable if in pointing out the importance of this new discovery Sir William Thomson had guarded against a very probable misconstruction of the purport of his letter.

The means of storing and restoring mechanical energy form the aspiration not only of Sir William, but of every educated mechanic. It is, however, a question of degree—of the amount of energy stored as compared with the weight of the reservoir, the standard of comparison being coal and corn. Looked at in this way, one cannot but ask whether, if this form of storage is to be the realisation of our aspirations, it is not completely disappointing. Large numbers are apt to create a wrong impression until we inquire what is the unit. Eleven million foot pounds of energy is what is stored in 1lb. of ordinary coal. So that in this box, weighing 75lb., there was just as much energy as in 1½oz. of coal, which might have been brought from Paris or anywhere else in a waistcoat pocket, or have been sent by letter.

When we come to the question of the actual conveyance of energy for mechanical purposes, this view is of fundamental importance. The weight of the same amount of energy in the new form is 800 times greater than the equivalent amount of coal; and as a matter of economy, supposing that energy in this form might be had at a certain spot and no capital were required for its conversion or storage, and that the energy were directly applicable it could not be carried ten miles—that is to say, such energy cannot be economically useful ten miles from its source, although coal had to be carried 100 miles to the spot. This limit, in truth, falls far short of what has been already attained by other means. By wire ropes and by compressed air or steam energy may be economically transmitted from 10 to 20 miles. So that if this is the utmost of what is to be done by means of the storage of electricity this discovery adds another door to those which are hopelessly closed against the possibility of finding in Niagara or other water power a substitute for our coal, even when the object is motive power, and much more for that purpose for which five-sixths of our coal is used—the production of heat.

It is very important that the people of this country should not shut their eyes to the fact that so far from there being a greater prospect of the solution of the problem than when, about twenty years ago, Professor Jevons raised the alarm, the prospect is now much smaller. In the meantime the capabilities of steel ropes, fluids in pipes, and electricity along conductors have been not only investigated, but practically tested and found altogether wanting. And now it would seem that the storage of electricity must be added to the list.—Yours, &c., OSBORNE REYNOLDS.

Owen's College, June 9.

TO THE EDITOR OF THE TIMES.

Sir: Professor Osborne Reynolds's letter in your issue of Saturday, the 11th inst., shows that the first idea that has occurred to him on reading Sir William Thomson's letter on Faure's "electric store," is probably what must have suggested itself to many engineers—viz., that so far from a million foot pounds being a surprisingly large amount of energy to be stored up in a mass of 75lb., it is really extremely small; and, indeed, while crossing over from Paris at the commencement of last week, I could not help thinking that the passengers were bringing to England literally in the smuts and blacks on their coats far more energy than had ever been imported into this country stored up in Faure's secondary batteries. But although it is perfectly true, as Professor Reynolds says, that 1½oz. of coal contains about one million foot pounds of work stored up in it, this is by no means all that has to be taken into account in considering this question; for where is the engine for extracting this million foot pounds of work out of the 1½oz. of coal? Indeed, as Professor Reynolds would himself tell us, we cannot get much more than one-tenth of this amount of work out of the 1½oz. of coal even in our largest steam engines, which burn many pounds of coal per minute, and in which much heat has been wasted in getting up steam. And if we come to the burning of one single 1½oz. of coal, I know of no engine that can obtain from this even one thousand foot pounds of work, or one thousandth of the energy contained in the coal, if no other coal be used in getting up steam or in previously heating the engine.

But if a secondary battery be allowed to drive a magneto-electro-motor or a dynamo-electric machine with separate exciter only even for the short time necessary to develop, say, 30 foot pounds of mechanical work, I anticipate this can be done without using up in the whole process more than about 35 foot pounds of the electric energy stored up in the reservoir, since the experiments of Professor Perry and myself have shown that, when the motor is running at high speeds with a light load, as much as 93 per cent. of the electric energy put into a magneto-electro-motor is given out again as mechanical work measured by an absorption dynamometer.

It may be answered, however, that if a small bit of coal, although containing a vast store of energy, is not of much practical use in producing work in consequence of the absence up to the present time of a proper converter of the coal's energy into mechanical work, at any rate a small galvanic battery (a little Daniell cell, for example) is not only a vast storehouse of power, but contains a store which we have the means of converting without appreciable loss into electrical light or mechanical work. How, then, is a Faure box a better store of electric energy than a little Daniell cell? This question has precisely the same answer as "Why is a pinch of dry gunpowder better than a pinch of wet?" Not because the dry gunpowder has more energy in it than the wet, but because the energy stored up in the dry gunpowder can be all, if we wish, used up quickly, and an explosion produced, whereas that in the wet can only be utilised bit by bit. So seven Faure boxes will produce an illumination of 100 candles in Swan lamps for six hours, while seven Daniell cells, or, indeed, twice that number,

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although possessing a store of power millions of times as great as that in the Faure boxes, will not illuminate a single Swan light.

Perhaps the most convincing proof of the fallacy of condemning secondary batteries because the energy they contain per pound weight is so much less than that in coal is the fact that a secondary battery, when working an electro-motor, takes the place not only of the coal used in a steam engine, but of the coal, the coal cellar, as well as of the furnace and boiler.

But while fully recognising the great advance made in the subject by Planté, and the recent improvements introduced by Faure, I do not wish to give the impression that the problem is by any means completely solved, since, if the attempt that Mr. Perry and myself, no doubt like many other electricians, are making to convert at a low temperature the energy in coal into electric energy meets with even a fairly satisfactory solution, then a fragment of coal, or, it may be, a puff of gas rich in carbon or carbonic oxide, will be a practical store of energy of incomparably greater value than any secondary battery.

W. E. AYRTON.

The City and Guilds of London Technical College, Finsbury.

A GRAPHIC METHOD OF REPRESENTING THE REACTIONS OF A DYNAMO-ELECTRIC MACHINE.

The theory of magneto-electric machines is now perfectly well known; but the same can scarcely be said of dynamo-electric machines, in which the current engendered by the machine reacts in its turn on the intensity of the magnetic field of the excitor. This is a want the more to be regretted since these machines are becoming so common for electric lighting or motive power.

It is satisfactory, therefore, to know that M. Deprez, the inventor of the Deprez motor, has discovered a very simple graphic method of calculating the value of the current generated by a dynamo-electric machine for all possible speed of the ring or coil and resistance of the external circuit. This method is based on the formation of an experimental curve which varies for different machines, and is termed the *characteristic* of the machine.

In order to draw it, all communication between the ring and the electro-magnets is suppressed, and a current of known strength is sent through the latter, from a foreign source; and then the ring is revolved at an arbitrary speed which should be the same in all the experiments. The difference of potential between the two extremities of the induced circuit is then measured by any of the known processes.

If the intensity of the auxiliary current sent round the exciting electro-magnets is varied, the difference of potential of the extremities of the induced circuit will experience corresponding variations, and by taking the intensities of the auxiliary current for the abscissæ of a curve and the differences of potential at the extremities of the induced current for ordinates the characteristic curve is obtained.

Now, in the Gramme machine and those of similar make, the difference of potential between the ends of the induced circuit is proportional to the speed of rotation.

If, now, we re-establish the connection which has been broken between the ring and the exciting electro-magnets, and close the circuit by a wire of any resistance whatsoever, taking care to suppress the auxiliary current, the curve allows us to determine immediately the intensity of the current generated, provided the total resistance of the circuit is known. In fact, if the intensity of the current is I, and E the difference of potential between the two extremities of the induced ring, with open circuit when the angular velocity is equal to unity, and R the total resistance of the circuit comprising the ring, the induced electro-magnets, and the exterior circuit, while W is the angular velocity of the ring itself, we have

$$I = \frac{\omega E}{R}$$

from which

$$\frac{I}{E} = \frac{\omega}{R}.$$

But $\frac{I}{E}$ is the co-efficient of inclination of a line passing through the origin, and through the point of which the co-ordinates are I and E, and, since this co-efficient should be equal to $\frac{\omega}{R}$, we arrive at the following construction.

The characteristic having been determined in the manner indicated it suffices, in order to know the intensity of the current generated under any conditions, to draw through the origin a straight line whose co-efficient of inclination is proportional to $\frac{\omega}{R}$. The intersection of this straight line with the characteristic curve will have for abscissa the intensity of the current sought, and for ordinate the generating electro-motive force of this current. If we desire to know what is the energy of the current it is expressed by E I; and to determine it immediately, another curve may be drawn with values of I for abscissæ and for ordinates E I. This very simple method permits of a ready solution of all questions relative to dynamo-electric machines. When the exciting electro-magnets instead of being traversed by the total current generated, only receive a part of it, as when the induced circuit is derived from the total circuit, the method applies with a slight modification. If we change the wire rolled upon the ring and the wire rolled on the inductors it still applies without having recourse to new experiments to establish a new characteristic curve. Again, where two machines are placed in the same circuit, one a generator and the other a receiver, the work transmitted can be found at once, if the speed of the generating machine, the resistance of the external circuit, and the resistant couple of the receiving machine are known, and also the characteristic curves of both machines.

Among the most interesting theoretic consequences of this graphic method is the following. *If the intensity of the magnetic field of the electro-magnetic exciters is proportional to the intensity of the current which traverses them, and if they do not possess any trace of permanent magnetism the characteristic will be a straight line passing through the origin.* It is easy to see that in this case the intensity of the current generated will be indeterminate or infinite, because, among all the lines having for inclination $\frac{\omega}{R}$, only one will cut the characteristic in an infinity of points. Such a hypothesis is, therefore, incompatible with reality. If we suppose now that there is a permanent magnetism, but that the proportionality between the increments of intensity of the exciting current and those of the magnetic field really exists, we find that to each value of $\frac{\omega}{R}$ greater than the inclination of the characteristic, there corresponds a determinate value of the current; but that it becomes infinite when the value of $\frac{\omega}{R}$ becomes equal to the inclination of the characteristic. This being impossible, we must conclude from it that the characteristic is never a straight line. It is, in reality, a line which does not pass through the origin, and of which the first portions have a very great radius of curvature, and the tangent ends by approaching nearly to a parallel to the axis of X, because the iron of the exciting electro-magnets tends towards the state of magnetic saturation.

THE SHETLAND ISLANDERS have a grievance in the very frequent interruptions in the telegraphic communication between Shetland and the south. There was not a single week all last winter that one or two annoying stoppages did not occur. The line passes over the Orkney Islands and through its impetuous tideways. There are no fewer than twelve land connections, and it lies on a rocky bottom. Early in spring this matter was brought under the notice of the Postmaster-General, but Mr. Fawcett stated that a new line would cost £10,000, and that the present cable did not pay. On 6th March the cable broke altogether, and since then Shetland has been entirely without communication with the south by wire. A memorial was then forwarded to the Postmaster-General, in which it was argued that the sole possible trade of Shetland—its fishing—depended upon telegraphic communication with the markets for its development. Mr. Fawcett promised that no time would be lost in sending a telegraph ship to repair the existing line. The Shetlanders argue that it is not fair to hold them responsible for the sum of £4,000, which is annually expended upon repairs, almost the whole of which are rendered necessary by the breakages in Orkney; and that for a sum not exceeding the amount expended every two years on such repairs they could have a direct cable, lying on a sandy bottom all the way, and steering clear of all tideways and land connections, which would last without repair for twenty years to come. They appeal to the members of the British House of Commons to help those who are trying all they can to help themselves.

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THE EVOLUTION OF DYNAMO AND MAGNETO ELECTRIC MACHINES.—IV.

By γ. β.

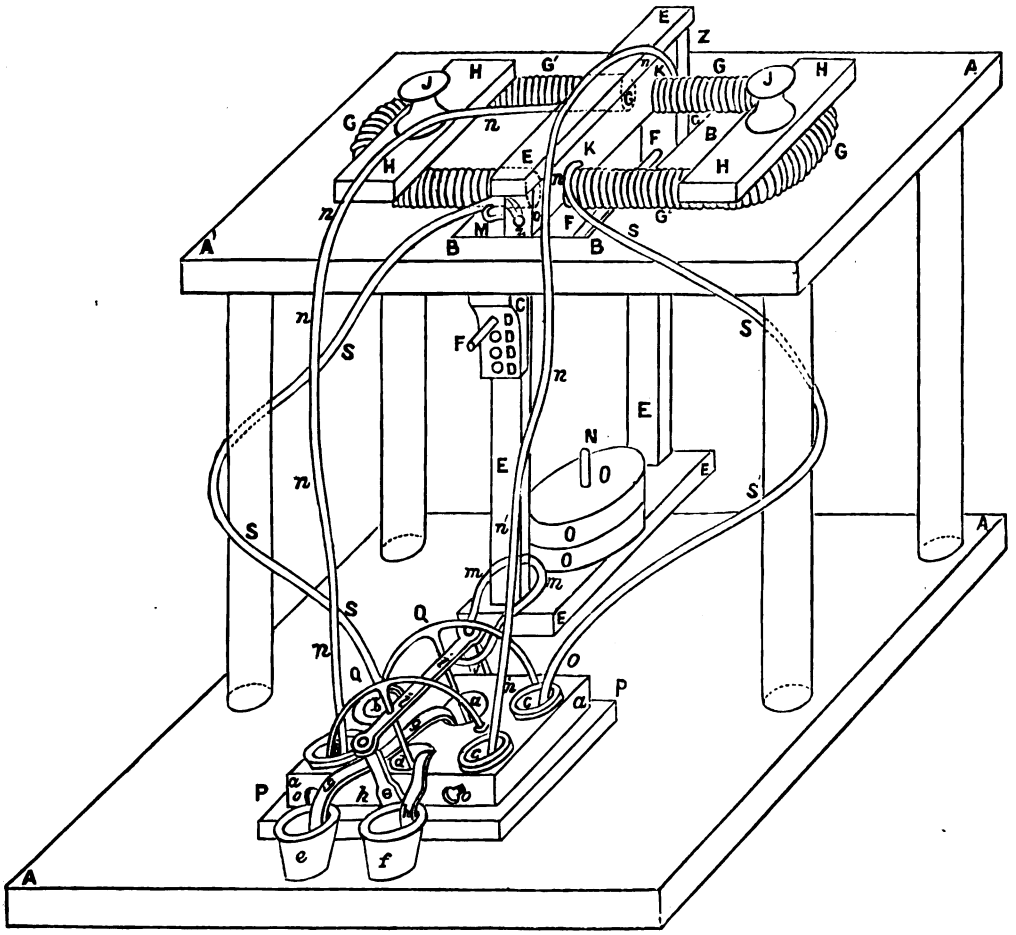
(CONTINUED FROM PAGE 41.)

It may be interesting to mention here, although it does not exactly correspond to the machines to be described in these papers, one constructed by William Sturgeon, in the autumn of 1832, and exhibited in London on 21st March, 1833. The apparatus is fully described in "Annals of Electricity," vol. 1, p. 75. With it Mr. Sturgeon performed many ordinary operations, such as sawing wood, &c.

A stout square board formed the base of the engine. At two opposite corners of this board are two uprights, carrying a cross piece. Two other uprights on this cross piece carried another cross piece. A shaft in metal bearings was placed between the base board and first cross piece. This shaft carried two circular channels, to be partly filled with mercury, also a cross piece carrying four metal quadrants, separated from each other by narrow radial openings.

The shaft also carried two compound magnets, one near the top, the other near the bottom, the poles of these magnets being in opposite directions. In the circumference of a circle concentric with the shaft, at equal distances from each other soft iron cylinders were placed, each covered with six coils of wire. The ends of these coils were joined to stouter wires, the upper ends to one set of four wires, the lower ends to four others. By means of four metal rods, in contact with the mercury and the respective quadrants, the current was transferred from one plate to another, and from one coil to another during a revolution. The engine was put into motion by two small batteries, and the contacts being properly made the iron cylinders became magnetic in succession, and by the joint attraction and repulsion of the permanent magnets and the temporary magnets, the former with the shaft and appendages, were pulled and driven round.

Dr. R. Schulthess, before the Philosophical Society at Zurich, in February, 1833, described the apparatus illustrated above. In this lecture he refers to the work of Salvatore Dal Negro, Professor of Natural Philosophy at Padua, and quotes from a paper of Dal Negro's as follows:—"As I had been successful in producing temporary magnets of very great power with very small electromotors, I endeavoured to apply this new power to moving machinery. I will now briefly state by what means I endeavoured to set a lever in motion. I first used a magnetic steel bar, placed vertically beneath one end of a temporary magnet; the bar vibrated from the attractions and repulsions which took place between its south pole and the north and south poles of the electro-magnet. In the same way a motion may be effected in a horizontal plane. I also set in motion a similar bar, by allowing a piece of iron, set free from the magnet at the moment when its power became = 0, to fall on one of its ends; after this it was immediately re-attracted. This can be effected in two ways; the one may be employed when a quick motion is to be produced, and the second when a greater force is wanted; in the first case the weight falls only just out of the power of the magnet's attraction, and the instant the weight has fallen upon the bar or lever it is re-attracted by the magnet that the action may be repeated; this weight is always very small in comparison with that which the magnet can support whilst in contact. In the second case the whole weight which the magnet can carry is employed, and use is made of the force which draws it to the magnet. This can be done in several ways. One of them forms a very powerful electro-magnetic ram. I shall not fail to make known the action of this new machine, and hope thereby to satisfy those in particular who are endeavouring to set a machine in motion at the least possible expense." He then describes his own apparatus as follows:—"On a small board, A′ A′, resting on four feet, are placed the two similar electro-magnets G G′; each of them weighs about the ⅛th part of a pound, and is wound round with 80 convolutions of copper wire of 0·5 line in diameter, covered with silk; they can be made to recede from or approach each other, and are fixed in their places by wooden screws, J J′. The board has in the middle a hole, B B, cut in it where the poles lie; in this a frame, E E, is hung, made out of four laths joined together, forming an oblong, of which the long sides are vertical. Under the upper side, and parallel with it, is the iron cylinder or armature K K′. Fixed in the side laths, and about 1½ inch below it, is placed a stout iron wire, F, parallel with the cylinder and passing through the sides of the frame, and two pieces of wood, C C, fixed in the under side of the board A′ A′; this wire serves as an axis, which allows to the frame a pendulum-like motion. That part of the frame which is below the axis is twice as long as the upper part, and weights, O O, may be placed on its base, E″ E″. The electric current was conveyed to the electro-magnets through a gyrotrope, P P, standing on the board A A, which serves as a basis to the



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whole machine. The wires from the electromotors are connected with the two middle cups of mercury *d d'*, in each of which dips the central portion of a wire bent into the form of an anchor, Q Q. These two wires are fixed to a wooden bow, by the motion of which the alternate ends of the two bent wires dip either into the cups on the one side or into those on the other; into the one cup *d'* dip the wires from *f*, coming from the one plate of the electromotor, and into the other cup *d* those from the other plate. The motion of this bow is effected in a very simple way by means of the motion of the frame E E' E'', so that when the iron cylinder is attracted by the electro-magnet on the right hand, the bow of the gyrotrope is driven by the lower part of the frame to the left hand, by which motion the left-hand electro-magnet is brought into action. The working of this little self-acting apparatus is so quick and efficient, that another small machine, for instance, a wheel, might very easily be set in motion by it. Before the result was quite successful, there was still another difficulty to be overcome. It is a well-known fact that electro-magnets, when the connection of the wires with the electro-motors is interrupted, do not instantly lose all their magnetism, but are capable of carrying a considerable weight for some time. The bad effects which this remaining magnetism would have on the motion of the armature between the two electro-magnets would, undoubtedly, be greatly counteracted by the magnets being placed with the dissimilar poles opposite to each other. In this form of arrangement it is evident that the magnet in action would be much stronger, and assist in destroying the remaining weaker magnetism in the other magnet. There would, therefore, be a moment when the magnetism became = 0, and at that moment I expected that the armature would be disengaged, and then be attracted to the active electro-magnet. However, this interval was of such momentary duration that the armature remained attached to the passive magnet. I then took, instead of the armature of soft iron, a steel magnet of exactly the same form and shape, and placed it so that its poles were always opposite to the similar poles of the electro-magnets; but even with this alteration the same result took place; it also happened when the electric current was sent at the same time, but in an opposite direction, to the other electro-magnet. As the power of the electro-magnet was considerably greater than that of the steel magnet, I could not expect to obtain more powerful effects than I had obtained with the soft iron. At last I determined to prevent any possible contact between the armature and the electro-magnets; this I effected by wrapping the armature up in paper, so as always to keep it at a small distance from the poles of the magnet. The result was now quite satisfactory. I also enveloped the steel magnet in the same way, and it appeared to me that with the first-mentioned armature the motion was quicker and more energetic than with the latter. If we consider that electro-magnets have already been made which were capable of carrying 20cwt., and that there is no reason to doubt that they may be made infinitely more powerful, I think I may assert boldly that *electro-magnetism may certainly be employed for the purpose of moving machines.*"

ON THE MODERN DEVELOPMENT OF FARADAY'S CONCEPTION OF ELECTRICITY.*

BY PROFESSOR HELMHOLTZ.

(The Faraday Lecture, delivered before the Fellows of the Chemical Society in the Theatre of the Royal Institution on Tuesday, April 5, 1881.)

LADIES AND GENTLEMEN: As I have the honour of speaking to you in memory of the great man who from the very place where I stand has so often revealed to his admiring auditors the most unexpected secrets of nature, I hope at the outset to gain your assent if I limit my exposition to that side of his activity which I know the best from my own experience and studies—I mean the theory of electricity, and his most important and most renowned discoveries lay in this field. The facts which he discovered are universally known. Every physicist at present is acquainted with the rotation of the plane of polarisation of light by magnetism, with dielectric tension and diamagnetism, and with the measurement of the intensity of galvanic currents by the voltameter, whilst induced currents act on the telephone, are applied to paralysed muscles, and nourish the electric light. Nevertheless, the fundamental conceptions by which Faraday was led to these much admired discoveries have not received an equal amount of consideration. They were very divergent from the trodden path of scientific theory, and appeared rather startling to his contemporaries. His principal aim was to express in his new conceptions only facts with the least possible use of hypothetical substances and forces. This was really an advance in general scientific method, destined to purify science from the last remnants of metaphysics. Faraday was not the first, and not the only man, who has worked in this direction, but perhaps nobody else at his time did it so radically. But every reform of fundamental and leading principles introduces new kinds of abstract notions, the sense of which the reader does not catch in the first instance.

Under such circumstances it is often less difficult for a man of original thought to discover new truth than to discover why other people do not understand and do not follow him. This difficulty must increase in Faraday's case, because he had not gone through the same common course of scientific education as the majority of his readers. Now that the mathematical interpretation of Faraday's conceptions regarding the nature of electric and magnetic forces has been given by Clerk Maxwell, we see how great a degree of exactness and precision was really hidden behind the words which to Faraday's contemporaries appeared either vague or obscure, and it is in the highest degree astonishing to see what a large number of general theorems, the methodical deduction of which requires the highest powers of mathematical analysis, he found, by a kind of intuition, with the security of instinct, without the help of a single mathematical formula. I have no intention of blaming his contemporaries, for I confess that many times I have myself sat hopelessly looking upon some paragraph of Faraday's descriptions of lines of force, or of the galvanic current being an axis of power, &c. A single remarkable discovery may, of course, be the result of a happy accident, and may not indicate the possession of any special gift on the part of the discoverer; but it is against all rules of probability that the train of thought which has led to such a series of surprising and unexpected discoveries as were those of Faraday should be without a firm, although perhaps hidden, foundation of truth. We must also, in his case, acquiesce in the fact that the greatest benefactors of mankind usually do not obtain a full reward during their lifetime, and that new ideas need the more time for gaining a general assent the more really original they are and the more power they have to change the broad path of human knowledge.

Faraday's electrical researches, although embracing a great number of apparently minute and disconnected questions, all of which he has treated with the same careful attention and conscientiousness, really always aim at two fundamental problems of natural philosophy, the one more regarding the nature of the forces termed physical, or of forces working at a distance; the other, in the same way, regarding chemical forces, or those which act from molecule to molecule, and the relation between these and the first. I shall give you only a short exposition on the degree of development which has been reached in the present state of science with regard to the first of these problems. The discussion of this question amongst scientific men is not yet finished, although, I think, it approaches its end. It is entangled with many geometrical and mechanical difficulties. How these are to be solved, and what are the arguments *pro* and *contra*, I cannot undertake to explain in a short public lecture with any hope of gaining your scientific conviction. I can, therefore, give only a short statement of this side of the question representing my own opinions; but I must not conceal the fact that several men of great scientific merit, principally among my own countrymen, do not yet agree with me.

The great fundamental problem which Faraday called up anew for discussion was the existence of forces working directly at a distance without any intervening medium. During the last and the beginning of the present century, the model after the likeness of which all physical theories had been formed, was the force of gravitation acting between the sun, the planets, and their satellites. It is known with how much caution, and even reluctance, Sir I. Newton himself proposed his grand hypothesis, which was destined to become the first great and imposing example of the power of true scientific method. We need not wonder that Newton's successors attempted at first to gain the same success by introducing analogous assumptions into all the various branches of natural philosophy. Electrostatic and magnetic phenomena especially appeared as near relations to gravitation, because electric and magnetic attractions and repulsions, according to Coulomb's measurements, diminish in the same proportion as gravity with increasing distance.

But then came Œrsted's discovery of the motions of magnets under the influence of electric currents. The force acting in these phenomena had a new and very singular character. It seemed as if this force would drive a single isolated pole of a magnet in a circle around the wire conducting the current, on and on without end, never coming to rest; and although it is not possible really to separate one pole of a magnet from the other, Ampère succeeded in producing such continuous circular

* From the *Chemical Society's Journal.*

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motions by making a part of the current itself movable with the magnet.

This was the starting point for Faraday's researches in electricity. He saw that a motion of this kind could not be produced by any force of attraction or repulsion working from point to point. The first motive which guided him seems to have been an instinctive foreboding of the law of conservation of energy, which many attentive observers of nature had entertained before it was brought by Joule to a precise scientific definition. If the current is able to increase the velocity of the magnet, the magnet must react on the current. So he made the experiment, and discovered induced currents. He traced them out through all the various conditions under which they ought to appear. He found that an electromotive force striving to produce these currents arises wherever and whenever magnetic force is generated or destroyed. He concluded that, in a part of space traversed by magnetic force, there ought to exist a peculiar state of tension, and that every change of this tension produces electromotive force. This unknown hypothetical state he called provisionally the electrotonic state, and he was occupied for years and years in finding out what this electrotonic state was. He first discovered, in 1838, the dielectric polarisation of electric insulators subject to electric forces. Such bodies, under the influence of electric forces, exhibit phenomena perfectly analogous to those observed in soft iron under the influence of the magnetic force. Eleven years later, in 1849, he was able to demonstrate that all ponderable matter is magnetised under the influence of sufficiently intense magnetic force, and at the same time he discovered the phenomena of diamagnetism, which indicated that even space, devoid of all ponderable matter, is magnetisable. The most simple explanation of these phenomena, indeed, is that diamagnetic bodies are less magnetisable than a vacuous space, or than the luminiferous ether filling that space. In this way real changes corresponding to that hypothetical electrotonic state were demonstrated, and now, with quite a wonderful sagacity and intellectual precision, Faraday performed in his brain the work of a great mathematician without using a single mathematical formula. He saw with his mind's eye that magnetised and dielectric bodies ought to have a tendency to contract in the direction of the lines of force, and to dilate in all directions perpendicular to the former, and that by these systems of tensions and pressures in the space which surrounds electrified bodies, magnets or wires conducting electric currents, all the phenomena of electro-static, magnetic, electro-magnetic attraction, repulsion, and induction could be explained without recurring at all to forces acting directly at a distance. This was the part of his path where so few could follow him; perhaps a Clerk Maxwell, a second man of the same power and independence of intellect, was needed to reconstruct in the normal methods of science the great building the plan of which Faraday had conceived in his mind and attempted to make visible to his contemporaries. Nobody can deny that this new theory of electricity and magnetism originated by Faraday and developed by Maxwell is in itself well consistent, in perfect and exact harmony with all the known facts of experience, and does not contradict any one of the general axioms of dynamics which have been hitherto considered as the fundamental truths of all natural science, because they have been found valid, without any exception, in all known processes of nature. A confirmation of great importance was given to this theory by the circumstances demonstrated by Clerk Maxwell, that the qualities which it must attribute to the imponderable medium filling space are able to produce and sustain magnetic and electric oscillations, propagating like waves, and with a velocity exactly equal to that of light. Several parts even of the theory of light are deduced with less difficulty from this new theory than from the well-known undulatory theory of Huyghens, which ascribes to the luminiferous ether the qualities of a rigid elastic body.

Nevertheless, the adherents of direct action at a distance have not yet ceased to search for solutions of the electro-magnetic problem. The moving forces exerted upon each other by two wires conducting galvanic currents had long ago been reduced in a very ingenious way by Ampère to attracting or repelling forces belonging to the linear elements of every current. The intensity of these forces is considered to depend, not only on the distance of both parts of the current, but also in a rather complicated manner on the angles which the directions of the two currents make with each other and with the straight line joining them both. Ampère was not acquainted with induced currents, but the phenomena of these could be derived from the law of Ampère, connecting it with the general law, deduced by Faraday from his experiments, and the current induced by the motion of a magnet or of another current induced by the motion of a magnet or of another current always resists this motion. The general mathematical expression of this law was established by Professor Neumann, of Königsberg. It gave directly, not the value of the forces, but the value of their mechanical work, the value of what mathematicians call an electro-dynamic potential, and it reduced electro-magnetic phenomena to forces acting, not from point to point, but from one linear element of a current to another. Linear elements of a wire conducting a galvanic current are, of course, complicated structures compared with electric atoms. I have myself elaborated several mathematical papers to prove that this formula of Professor Neumann's was in harmony with all the known phenomena exhibited by closed galvanic circuits, and that it did not come into contradiction with the general axioms of mechanics in any case of electric motion. I succeeded in finding an experimental method of observing electrostatic effects of electro-magnetic induction under conditions in which closed circuits could not be generated. This experiment decided against the supposition that Neumann's theory was complete so long as only the electric motions in metallic or fluid conductors were considered as active currents, but it was in accordance with the theory of Faraday and Maxwell, who supposed that from the extremities of conducting bodies, when an electric charge collects, electric motion is continued through the insulating media separating them. Other eminent men have tried to reduce electro-magnetic phenomena to forces acting directly between distant quantities of the hypothetical electric fluids with an intensity which depends, not only on the distance, but also on the velocities and accelerations of those electric quantities. Such theories have been proposed by Professor W. Weber, of Göttingen; by Riemann, the too-early-deceased mathematician; and by Professor Clausius, of Bonn. All these theories explain very satisfactorily the phenomena of closed galvanic currents. But, applied to other electric motions, they all come into consideration with the general axioms of dynamics.

The hypothesis of Professor Weber makes the equilibrium of electricity unstable in any conductor of moderate dimensions, and renders possible the development of infinite quantities of work from finite bodies. I do not find that the objections brought forward at first by Sir W. Thomson and Professor Tait in their "Treatise on Natural Philosophy," and discussed and specialised afterwards by myself, have been invalidated by the discussions going on about this question.

The hypothesis of Riemann, which he did not himself publish during his lifetime, labours under the same objection, and is at the same time in contradiction to Newton's axiom, which established the equality of action and reaction for all natural forces. The hypothesis of Professor Clausius avoids the first objection, but not the second, and the author himself has conceded that this objection could be removed only by the assumption of a medium filling all space, between which and the electric fluids the forces acted. The present development of science shows then, I think, a state of things very favourable to the hope that Faraday's fundamental conceptions may in the immediate future receive general assent. His theory, indeed, is the only one existing which is at the same time in perfect harmony with the facts, as far as they are observed, and does not beyond the reach of facts lead into any contradiction of the general axioms of dynamics. Clerk Maxwell himself has developed his theory only for closed conducting circuits. I have endeavoured during the last few years to investigate the results of this theory also for conductors not forming closed circuits. I can already say that the theory is in harmony with all the observations we have on the phenomena of open circuits. I mean (1) the oscillatory discharge of a condenser through a coil of wire, (2) my own experiments on electro-magnetically induced charges on a rotating condenser, and (3) Mr. Rowland's observations on the electro-magnetic effect of a rotatory disc charged with one kind of electricity. The deciding assumption which removes the theoretical difficulties is that introduced by Faraday, who assumed that any electric motion in a conducting body which charges its surface with electricity is continued in the surrounding insulating medium, as beginning or ending dielectric polarisation with an intensity equivalent to that of the current. A second inference from this supposition is that the forces working at a distance do not exist, or are at least unimportant, when compared with the tensions and pressures of the dielectric medium. It is not at all necessary to accept any definite opinion about the ultimate nature of the agent which we call electricity. Faraday himself avoided as much as possible giving any affirmative assertion regarding this problem, although he did not conceal his disinclination to believe in the existence of two opposite electric fluids.

(TO BE CONTINUED).

ACCIDENTS BY LIGHTNING.—The *Colonies and India* says with regard to the killing of 800 sheep by a lightning flash at Coolah, N.S.W., the flash "made a lane through the flock," some 9,000, as they "were in camp," and therefore packed close together.

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PHYSICAL SOCIETY.—JUNE 11.

Lord RAYLEIGH in the chair. New members: Mr. J. E. H. Gordon and Mr. J. E. Stead, E.I.C.

Professor FLEMING, of Cambridge, exhibited a new form of British Association unit of resistance coil devised by him for temperature experiments on the comparison of resistances carried out in the Cavendish Laboratory. The old form of resistance unit is filled in with paraffin wax between the electrodes, and this is exposed to the air. As a consequence, when immersing these coils in hot or ice-cold water, a film of condensed moisture is apt to gather on the exposed surface of the paraffin and short circuit the coil. In the new coil this is obviated by entirely enclosing the coil in a brass box composed of two flanged caps screwed together tightly. They may be further rendered watertight by grooving the edges of the flanges where they meet and running in solder, or by the use of an india rubber washer between them. The old coil, too, took a considerable time to attain the true temperature of the liquid it happened to be immersed in, or of the atmosphere itself, and Professor Fleming has overcome this difficulty by employing *bare* platinum-silver wire for the coil, and insulating each layer and turn from the rest by means of little ebonite fenders introduced between the layers and niched out to receive the turns of wire. In this way the coil attains the temperature of the medium in five minutes or so, instead of half an hour as formerly.

Dr. STONE stated that in order to prevent the short circuiting of the old coil, and to secure its insulation when immersed in ice cold water, he followed the plan of plunging the coil in a beaker of paraffin oil, and then placing this beaker within the water.

Professor AYRTON drew attention to the practice of makers in taking great pains to adjust resistance coils to a particular value, whether units, tenths, or hundredths. This practice greatly increased the expense of the coils without necessity. What was wanted was to know the exact resistance, whether fractional or otherwise, of any piece of wire at a given temperature, and calculation could do the rest.

Lord RAYLEIGH expressed a doubt about the water tightness of a simple screw joint under water; and Professor Fleming replied that soldering could be resorted to for permanent purposes, and a lead or india rubber washer for temporary purposes. It was an advantage to be able to increase the caps and examine the coil.

HARDENING OF STEEL.

Professor W. CHANDLER ROBERTS read a paper "On the Hardening and Tempering of Steel." He pointed out that few questions connected with the metallurgy of iron and steel are attracting more attention now than the relation between a metal and the gases it comes into contact with during manufacture. The carburisation of iron has long been of great interest, as shown by the work of Clouet at the end of last century, and that of Margueritte in 1865, who showed that, though the conversion of iron into steel could be effected by contact with carbon, even in the diamond form, it is, nevertheless, true that in the ordinary process carbonic acid plays a considerable part, which had been overlooked. Graham's 1867 paper on the occlusion of gases by metals gave point to Margueritte's work by showing that carbonic oxide can penetrate to the centre of a mass of iron. It is introduced, in fact, at a comparatively low temperature, while a high temperature is necessary to enable the metal to appropriate the carbon and become steel. Metallurgists are now carefully investigating the effect of occluded gases in iron and steel. Professor Roberts considered the point recently raised as to whether the hardening and tempering of steel might not be influenced by the occlusion or expulsion of gas. He described experiments by which he proves that, as steel hardens when rapidly cooled in vacuo, gases could not play any part in the tempering. He also dwelt on the precautions necessary to keep the metal in the experiment free from occluded gas. He then showed that Bergman (to whom we owe our knowledge that the difference between wrought iron and steel depends on the carbon in the latter) showed in 1781 that fixed air could give up its carbon to iron; and he concluded by showing that Reaumur so long ago as 1722, actually employed the Toricellian vacuum in experiments on the tempering of metal, the metal being placed red hot in a highly rarefied atmosphere. Reaumur also had a clear view of the effect a gas might have on the physical properties of a metal, a point of great interest to physicists in general.

Professor HUGHES expressed the opinion that temper was not due to absorption of hydrogen, but to the absorption of carbon in the iron.

Mr. STROH found that an electrically-fused steel contact was glass hard.

Professor GUTHRIE exhibited a steel chain which he had beautifully blackened by dipping in fused nitre. The skin might be useful in the arts, and was, perhaps, analogous to that produced by Barff's process.

Lord Rayleigh, Mr. Walenn, Mr. Lecky, Dr. Coffin, Professor Ayrton, and others continued the discussion.

ELECTRO-MAGNETIC INDUCTION.

Mr. GRANT then read a paper "On Curves of Electro-magnetic Induction," which he had traced out by means of primary and secondary coils sliding on frames, so as to take different positions with respect to one another. The paper was illustrated by experiments and diagrams.

Professor REINOLD then read portions of a paper, by Professor S. P. Thomson, "On the Opacity of Tourmaline Crystals." The optical and electric properties of these crystals are related, and Professor Thomson propounds an explanation of this connection, based on the late Clerk Maxwell's electro-magnetic theory of light. The full paper will be published in the *Journal* of the Society.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices June 15.		Business Done Week Ending June 15. Highest.	Lowest.
Anglo-American	55,	¼	55¼	55¼
Do. Preferred	86,	87	87½	86½
Do. Deferred	27,	¼	27½	27½
Brazil Submarine	10¾,	11	11	10¾
Cuba	9½,	¾	9½	9½
Do. Preference	16¾,	17¼	—	—
Direct Spanish	4,	¼	4¼	4¼
Do. Preference	13½,	14½	14	14
Direct United States Cable	10¾,	11¼	11¼	10¾
Eastern Telegraph	10½,	¾	10¾	10½
Do. 6 per Cent. Preference	12¾,	13¼	13¼	13
Do. 5 per Cent. Debentures, 1899	107,	110	108½	107½
Eastern Extension	11½,	¾	11¾	11½
German Union	11½,	12	—	—
Globe Telegraph and Trust Company.	6¾,	¼	6¼	6¼
Do. Preference	12¾,	¾	12¾	12¼
Great Northern	13,	¼	13½	13¼
Indo-European	28,	29	—	—
Mediterranean Extension	2¼,	¾	2¾	2¼
Do. Preference	9¾,	10¼	—	—
Reuter's	11,	12	11¾	11¾
Submarine	270,	290	283	288
West India and Panama	2½,	¼	2¾	2¼
Do. 1st Preference	7¾,	8¼	7¾	7¾
Western Brazilian	8½,	¼	8¾	8¼
West. Union 7 per Cent. 1st Mortgage	123,	128	126½	126
Do. 6 per Cent. Sterling Bonds	106,	110	—	—

TRAFFIC RECEIPTS FOR MAY, 1881.

Companies.	May, 1881.	May, 1880.	Increase.	Decrease
Anglo-American Telegraph Company	£49,880	41,970	7,910	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	3,000	2,972	28	—
Direct Spanish Telegraph Company	1,547	1,334	213	—
Direct United States Telegraph Company	16,630	13,990	2,640	—
Eastern Telegraph Company	43,872	42,963	909	—
Eastern Extension Telegraph Company	29,523	26,570	2,953	—
Great Northern Telegraph Company	21,600	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company.	—	—	—	—

THE "JAMIN" PATENT ELECTRIC LIGHT,
COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

FOR SALE.—Second-Hand INDUCTION COIL (3 inch spark), GROVES BATTERY (6 quarts), VACUUM TUBES and ROTATOR, HENLEY'S DISCHARGER, BICHROMATE BATTERY (2 quarts). Full particulars on application to J. LIDDY, 14, Wornington-gardens, Notting Hill.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby.

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RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

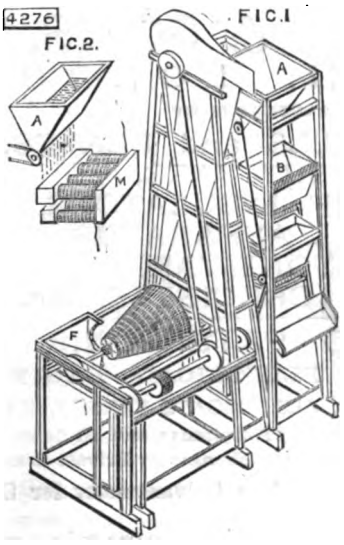
229. Restoring Waste Vulcanised India rubber or Gutta percha, &c., *H. H. Lake. Dated 18th January*, 1881.—(*A communication from H. A. Clark.*)—(*Complete.*) 6*d*.

This consists, 1st, in restoring waste vulcanised india rubber by first moistening and dampening the material with water and evaporating such water, and then moistening and dampening the material with turpentine, camphene, or equivalent substances, and subsequently heating or evaporating the turpentine or the like; 2nd, in the treatment of waste vulcanised india rubber or gutta percha and the compounding of a vegetable oil or oils, or a resinous material or materials, or both with the same; 3rd, of an insulated wire wrapped with a strip or sheet of tin foil or other suitable material in such a manner that it runs in the direction of and parallel with the length of the wire, and is surrounded by an insulating material.

4276. Improvements in the Mode of and Apparatus for Separating Impurities from Auriferous Ores, and in the Treatment of Such Ores, *E. G. Brewer.—Dated 20th October*, 1880.—(*A communication from T. A. Edison*). 6*d*.

The material to be treated is fed into hopper F, whence it passes into a sieve. An elevator conveys the material to the hopper A of the first separator, whence it falls in front of the magnet M. Below M is a hopper, B, receiving the non-

4276 FIG.2. FIG.1



magnetic portion and passing it before a second magnet, the magnetic portion falling into a receptacle for the purpose, and thence to a waste shoot. This construction is repeated until as many separators as may be desired are arranged in series.

4129. Improvements in Electrical Signalling and Indicating Apparatus for Telephonic or Telegraphic Purposes, *W. R. Lake.—Dated 11th October*, 1880.—(*A communication from F. Blake.*) 6*d*.

The inventor makes use of a number of synchronously revolving dials under the control of a battery current upon a single circuit, but acting automatically, each at a separate time, to ring a magnetic bell by diverting through or grounding through the bell a magneto current generated at the central office, in combination with a device, under the control of the operator at the central office, by which the automatic operation of the dial at the central office may coincide with that of the dial at either of the out stations. Fig. 1 is a front elevation of an instrument used for carrying the invention into practice. Fig. 2 shows how the circuit and branches are arranged when the invention is applied to a group of a central and two out stations, and the magneto bell is to be rung by diverting a magneto current through it. In Fig. 1 A is a wooden table, B a brass frame for clockwork C, operated by a coiled spring, D is a disc

4129 FIG.1.

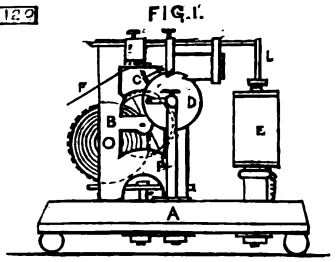
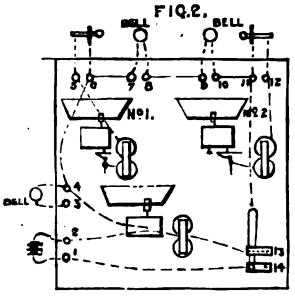


FIG.2.

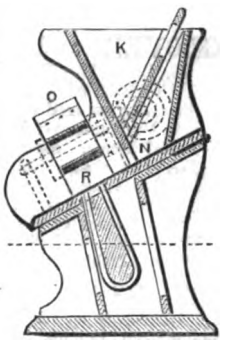


on a shaft revolved by the clockwork, F a governing fan, E an electro-magnet. An armature is rigidly secured to a weighted bell-crank lever L, secured to a post P rocking on a pin inserted in an arm. L carries a catch which takes into a notch in the periphery of D, and also carries a weight sufficiently heavy to lift the armature when not attracted by the electro-magnet. D is of metal, and has a slot which is filled with a hard india rubber plug. P is a brass post bearing a metallic shaft carrying a pointer, which is an electrode, and is furnished with a platinum point, at all times in contact with the disc, the plug coming in contact with it at each revolution of the dial. Each station is provided with a magneto-bell connected with a magneto-electric machine on the main line, the central station being furnished with a battery as indicated, and a key, the spring arm of which in its normal condition is in contact with Plate 13, Fig. 2, but when depressed, with Plate 14. Each station is provided with screw caps numbered 1 to 12, connected as shown in figure.

4310. An Improved Magnetic Apparatus for Separating or Removing Particles of Iron from Grain, *W. R. Lake.—Dated 22nd October*, 1880.—(*A communication from S. Howes, N. Babcock, and C. Ewell.*) 6*d*.

The grain to be treated is conveyed into the hopper K, from which it flows upon and over the zinc plate N, being discharged over its lower edge. The particles of iron mixed with the grain are

4310

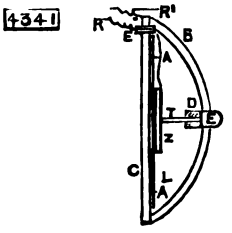


subjected to the action of magnets of the other side of N, and are held while the grain passes on. At certain intervals the wiper O traverses N, and sweeps up the particles of metal, discharging them through R into any suitable receptacle.

4341. An Improved Electrical Apparatus for Operating Bells, Signals, and Telegraphs, *G. Skrivanoff.—Dated 25th October*, 1880. 6*d*.

In the figure, B is the ebonite cover, C the back plate of retort charcoal fitted within B, and fixed to the wall. C is partially faced with a layer of blotting paper or asbestos, A, which adheres to C by means of a small quantity of paraffin; at its upper part a plate of zinc, Z, is placed parallel with A, as shown, and is soldered to the copper rod T, the other end of which passes through the spiral spring D, and is attached to knob E. Near the edge of C is a hole through

4341



which a split copper tube is passed, at one end of which a long tongue of copper is left, which is kept in place by a hollow ebonite cylinder, E^1; to the free end of the tongue the negative wire R is attached. To copper rod T is attached strip of copper, to which is secured electro-positive wire R, which passes through E^1. These wires are carried to the bell or signal to be operated. Before uniting C to B, the inventor puts into the lower part at L crystals of chlorochromate of potass strengthened by an eighth part of sulphuric acid.

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Further information can be obtained on application to the Secretary.

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All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

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Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited),
HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

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Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

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Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER
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Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

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THE
ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION
(LIMITED).

Capital £800,000; First Issue £400,000.

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The Corporation is prepared to give estimates, and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.
The Corporation is also prepared to receive applications for licences, or for concessions for defined districts, and to enter into negotiations with responsible parties for the sale of licences for the British Colonies. The superiority of the Brush system in economy and simplicity being thoroughly established, its rapid development is now assured.
By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.
All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

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Established 1836.
Head offices—Aberdeen and London.

Subscribed Capital	£3,000,000
Of which paid up	300,000
Fire Reserve Funds	637,977
Life Funds, as per last account	£1,462,146

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Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

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Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.

Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.

NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.
Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
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A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

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A Pamphlet, with full particulars, on application.
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SLIP

THE TELEGRAPH IN BARBADOES.—A loan has been asked for of £650 for inland telegraphs.

WEST INDIES.—The cables between St. Lucia and St. Vincent, and between Antigua and Guadeloupe are interrupted.

BOZNIA AND HERZEGOVINA.—Notice has been issued that private telegrams in code or cypher for these countries will not be accepted.

ELECTRIC LIGHT AT KING'S CROSS.—The Great Northern Railway Company have adopted the Crompton electric light at their station at King's Cross.

BRAZILIAN SUBMARINE COMPANY.—The traffic receipts of the Brazilian Submarine Telegraph Company (Limited) for the week ended the 17th inst. amounted to £2,876.

ACCIDENT BY LIGHTNING.—A heavy thunderstorm burst over Canterbury last week. The lightning was very vivid, and the Unitarian Chapel and other buildings were struck.

WEST INDIA AND PANAMA TELEGRAPH COMPANY.—This company is trying to obtain an increase in the subsidy given them by Jamaica from £2,000, its present amount, to £5,500.

THE TELEPHONE IN AMERICA.—Telephones are being extensively used in the coal regions between Reading and Pottsville, U.S.A., and an extension as far as Philadelphia will soon be complete.

OVERHEAD *v.* UNDERGROUND WIRES.—The vestry of Plumstead the other day refused their sanction to the erection of six iron telegraph poles along Burnt Ash-lane, at Lee, by the General Post Office.

ELECTRIC LIGHT AT THE ALEXANDRA PALACE.—On Saturday last, for the first time, the Alexandra Palace and a portion of the grounds at Muswell Hill were lighted by means of sixteen Brush electric lights.

MRS. FAWCETT.—On Tuesday last Mrs. Fawcett addressed a meeting of women, warmly advocating the formation among them of trades unions. It is not stated whether any women telegraphists were invited to be present.

THE TELEPHONE IN DUNDEE.—The telephone seems to be coming into favour in Dundee, the Dundee and District Telephone Company having lately obtained permission for the erection of some new lines, amongst others one to the police station.

SWAN'S LAMP ON SHIPBOARD.—The ss. "Chateau Leoville," built for a French company by the Sunderland Shipbuilding Company, and recently launched at Sunderland, is to be fitted with the Swan incandescent lamp. She will ply between Bordeaux and New York.

WESTERN BRAZILIAN COMPANY.—The traffic receipts of the Western and Brazilian Telegraph Company for the week ending June 18 amounted to £2,066, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

THE ELECTRIC LIGHT AT SOUTH KENSINGTON.—At the opening of the Domestic Economy Congress on Monday last, at the Albert Hall, the Royal Horticultural Society's Gardens were illuminated by electric lights. The effect is described as having being most beautiful.

TELEPHONE IN NEW ZEALAND.—The Telephone Exchange, mentioned a month or two ago as proposed to be introduced, is being established at Christchurch, New Zealand, some thirty of the principal firms having agreed to pay the charges, £17 10s. each.—*Colonies and India.*

ANOTHER AGGRIEVED TELEGRAPH CLERK.—The telegraph clerk at Craughwell, Co. Galway, named Edward J. Barrett, was arrested on Saturday last, under the Peace Preservation Act. Several presents, however, were made to him by the the ladies of the local branch of the Land League before his departure.

ELECTRIC LIGHT IN PARIS.—During the series of concerts that are to be given in the course of the next three months at the Palais Royal, the gardens will be illuminated by eighteen Jablochkoff lamps. Last year eight Siemens lamps were employed. The Jablochkoff lamps will cost some thousand francs per month.

ELECTRIC LIGHT FOR EDINBURGH.—It is proposed to illuminate this city with the Brush electric light on the occasion of the Queen's visit in August. The experiments will be confined, we believe, to Princes-street and the North Bridge, but if successful the system will probably be extended to other prominent parts of the city.

THE TELEGRAPH CLERKS' GRIEVANCES.—According to latest information, the clerks are exceedingly dissatisfied with the proposed remedial measures; but have decided to withdraw from their resolution not to work overtime after the 27th inst., the object of their agitation in respect to that particular grievance having been accomplished.

ELECTRICITY AMONG THE NIHILISTS.—Amongst the officers arrested as implicated in the proposed plot on the guard ship off Peterhoff against the Czar's life was a certain Lieut. Khotinski, who is also implicated in the Mala Sadowa-street mine. He has been connected with electric light production, and is said to be a man of scientific mark.

PRICES.—The prices as quoted are:—For gutta percha, per lb., genuine, 4d. to 3s. 3d.; reboiled 3d. to 1s. 3d. For india rubber, fine Para 3s. 6½d. to 3s. 6¾d., negrohead 2s. 3½d., central American 2s. to 2s. 6d., Assam and Pegu 1s. 3d. to 2s. 2d., other East Indian 1s. 9d. to 2s. 4d., Madagascar and Mozambique 1s. 6d. to 2s. 4d. The market remains flat.

OVERTIME.—The Postmaster-General has explained that the clerk attached to the Western London District who is suffering from mental derangement owing to excessive work undertook the overtime voluntarily, but that steps would be taken under the new scheme to guard against such prolonged duties. The sick man in this instance will receive full pay.

MORE ELECTRICAL PAPERS.—Paris is becoming the headquarters of electrical publications just now. We suppose that the excitement caused by the preparations for the Electrical Exhibition has given the motive force to the publishers. The *Telephone*, a weekly paper, has just made its appearance, and we are promised the first number of the *Electrophone* shortly.

ELECTRIC LIGHT FOR MONTROSE.—There is a likelihood of the ancient town of Montrose in Scotland being lit up by electricity. The Town Council are to be asked to light High-street and the public buildings for a month during the autumn to see what the expense and effect will be. A resident of Montrose has promised to supply a dynamo machine gratis if the Town Council will supply the lights.

TELEGRAPHS IN AMERICA.—The following is an instance of some of the difficulties with which American telegraph companies have to contend on their land lines:—A whirlwind passed over the city of Deadwood, Dakota, on the 6th June, and rooted up the telegraph poles for more than a mile. These whirlwinds are very frequent in parts of America, and often do immense damage to telegraph lines.

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THE TELEPHONE IN CHRISTIANIA.—In the numbers of *Naturen* for this year the editor describes the working of the telephone system in Christiania, where, since June, 1880, a central station, in which the work is done by women, has been established in connection with Dr. Bell's company in New York, under the direction of Herr Hugo Ullitz. The apparatus used is the so-called Blake's microphone.—*Nature.*

REUTER'S COMPANY IN INDIA.—Mr. Williams, superintendent of Reuter's Company, India, has arrived at Simla, says the *Homeward Mail*, and on behalf of the company has offered to undertake gratis the supply of the whole of the Press Commissioner's service to the Indian press, in consideration of obtaining early information for despatch to the home press. The Government, whilst willing to maintain the office, will not incur any expense for the establishment.

THE PARIS ELECTRICAL EXHIBITION.—The Earl of Crawford and Balcarres, F.R.S., has been appointed British Commissioner to watch over British interests at the forthcoming exhibition. The appointment of his lordship, who is better known as Lord Lindsay, has been received with great approval. It is proposed to hold a meeting of exhibitors on Tuesday next to consider final arrangements. Lord Crawford will preside. The exhibition will open on August 1st without fail.

THE WIRE TRADE IN SHEFFIELD.—The *Ironmonger* says:—"The leading manufacturers in the town of crucible-steel wire have very good orders on hand now for wire for telegraph, cable, and other purposes, and some are better employed now than for a long time past. The introduction of Bessemer steel wire has wrought great changes in this branch of trade, and has excited an amount of competition altogether unknown in years gone by. Prices at present are very low."

TELEGRAPH STORES WANTED.—The Directors of the North-Eastern Railway invite tenders for the undermentioned articles, in such quantities as they may require during the six months ending 31st December, delivered carriage paid at the company's telegraph stores at York:—Telegraph apparatus, telegraph wire, and line stores. Forms of tender on application to Mr. Graves, Telegraph Department, York, and tenders must be sent to the secretary at York, sealed, and marked "Tender for Telegraph Stores," by the 29th inst.

ELECTRICAL SOCIETY FOR SPAIN.—The proposed electrical society for Spain is to do something more than enroll members who will contribute papers, &c. The programme includes the formation of a central depôt from whence no less than 200 horse-power shall be forthcoming for use in the distribution of electricity for purposes of illumination and motive power within a certain radius round the depôt. The society will also manufacture lamps, telephones, &c. We believe, however, that the above exists at present only on paper.

SELENIUM RODS FOR PHOTOPHONES.—Herr Weinhold makes his selenium rods of small glass tubing a few centimetres long and 1.5 millimetres thick, with two small spokes fused to each end to connect with the wires. A double thread is cut into the tube by coating it with a spirally winding layer of sealing wax and exposing it to the action of an aqueous solution of hydrofluoric acid for a few minutes. Small brass helices are then wound round the thread in opposite directions, and the spaces between the double thread are coated with selenium.—*Dingler's Journal.*

THE FAURE BATTERY AND TRAM CARS.—One the 10th of June one of the tram cars of the Compagnie Générale des Omnibus was driven over the Vincennes tram line from the Boulevard Richard Lenoir to the Barrière du Trône and back, at a speed of 10 kilometres an hour, by means of the Faure battery. One hundred and sixty accumulators were used, weighing altogether about 1,300 kilos., the cost of which is about 20,000 francs. The same work could have been done by two of the company's horses, which cost about 1,300 francs each to begin with, and another three francs per diem to keep.

ELECTRIC LIGHT AT BARCELONA.—A successful trial of the electric light took place at Barcelona in April last, when the San Ramon Quay was illuminated by five Gramme lamps, four of which were placed at an elevation of six metres above the ground, and the fifth at ten metres; the distances between them being 60, 100, 125, and 150 metres respectively. The current was produced by a Gramme continuous current machine. The wire, after having been connected to the last of the five lamps was put to earth at once, there being no return wire. The light was also used on one night to illuminate the exhibition of paintings at the Athenæum of Barcelona, and is said to have given good results.

A NEW FORM OF MORSE ALPHABET.—Mr. Richard Herring has sent us specimens of his universal telegraphic alphabet, which is simply the Morse alphabet arranged vertically, for instance ||| signifies O. Mr. Herring suggests that a handy primer should be compiled for use in Board Schools as a reading book, and so make the young of both sexes familiar with this alphabet. We certainly think there is a great deal in Mr. Herring's suggestion. There can be no doubt that the printing of the signs vertically instead of horizontally saves a great deal of space, and we should think minimises the chances of error through mistaking a dot for a dash and *vice versa*, as is so frequently the case with the ordinary Morse alphabet.

SORTERS AND TELEGRAPHISTS.—There is no longer any doubt as to the *status* of the telegraphist in this country. He ranks as a letter sorter. We are not competent to express an opinion as to the justice of this classification; nor can exception be taken to the training of these classes—the sorter and the telegraphist—each in their respective duties. But we do quarrel with the assumption underlying the proposal, namely, that an interchange of duties will be easily and efficiently carried out—at all events, on the part of the sorter. To suppose that a sorter who has occasionally practised on a telegraph instrument could be employed on telegraph duties in cases of emergency—for that is what is meant—is like proposing to call in the linemen when there is an extra rush of traffic.

WHY NOT?—A writer in the *Gas Journal* says:—"Supposing that all, and yet more, which might be said about lighting by electricity should be realised, What about gas companies and the manufacture and sale of gas? I know of no reason why the companies should not be as successful as they are now; the quantities of gas produced greater than they have ever been; just prices maintained; and full dividends paid. The manufacture of gas must go on; areas of supply will be extended; and what will be preferable, because more profitable, existing areas will be better worked by the uses for gas being increased—say, for warming, cooking, driving engines, and other useful and economical applications. Why should gas not be an auxiliary to electrical lighting by working dynamo machines?"

TELEGRAPHIC COMMUNICATION WITH SHETLAND.—In the House of Commons on Monday, Mr. Laing asked the Postmaster-General what steps were being taken to restore telegraphic communication with Shetland, which had been for some time interrupted, to the serious detriment of the

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trade and fisheries of the district; and whether, when the Post Office had undertaken to provide telegraphic communication for a considerable district, it was their duty to maintain such communication in a state of efficiency, and to restore it without delay if interrupted from unavoidable causes. Mr. Fawcett said he as much as anybody regretted the interruption. The delay in repairing the cable had arisen solely from the difficulty in obtaining a cable ship to proceed with the work. They had now secured the first one available, which on its return from the West Indies would immediately proceed to Shetland.

The Telegraphists as Electors.—We could never understand what the telegraphists meant by claiming to have the support of some two or three hundred members of Parliament. The correspondence between the Postmaster-General and the Treasury has enlightened us. It appears that the telegraphists have got votes, and that the fact has been communicated to the proper quarters. This we are told was very naughty. Telegraph clerks have no business to know that they have votes until the day of the poll, or, indeed, to have votes at all if they embarrass the Government. Another proposal revealed—somewhat indiscreetly, it seems to us—in this extraordinary correspondence, is to treat a refusal to work as penal. Coming from a Liberal administration these menaces will considerably perplex the future historian of modern politics. To us they appear to be vain threats very inopportunely promulgated.

Secondary Batteries.—The *New York Times* of the 7th of June, in a short article on this subject, says:—"The secondary pile of Mr. Higgs overcomes a defect which prevents the Planté or Faure battery from coming into general use. With both the latter, when once the poles are connected, the charge is rapidly exhausted and irregular in its delivery. With the Higgs pile the discharge is uniform, or nearly so, and it can be used to operate an electric lamp on the parlour table or for any laboratory or physiological experiments which may be in progress at the moment. By using very short arcs the English electrician has been successful in operating a 40-candle light with secondary electricity, without engine or dynamic generator; and he believes that the time will come when such cells will be sold in the market for illuminating purposes, and when the electric lamp will be in as common use as the kerosene for the parlour table."

Overhead Wires.—At the meeting of the Court of Common Council of the Corporation of London held last week, Mr. J. V. Moore asked the chairman of the Commissioners of Sewers (Mr. Ashby) if he had seen the reply of Mr. Gladstone to Sir Henry Tyler that the local authorities were responsible for damage and injury resulting from the telegraph wires; and whether, in view of this reply, the Commissioners of Sewers acknowledged that responsibility and obligation; and if so, what steps they were taking to see that the wires were properly secured.—Mr. Ashby was exceedingly surprised at the statement, which was of so extraordinary a character that he could scarcely believe that the Prime Minister had been correctly reported. He apprehended, however, that this was simply the statement of an opinion rather than a declaration of law, and it must be the law that ruled in this matter, and not an opinion even of the first subject in the realm. The Commissioners not only repudiated any such responsibility, but should be prepared to dispute it in the courts of law to the utmost of their power.

Tampering with Telegraph Messengers.—Benjamin Hill, an ex-policeman, was charged at Bristol recently with endeavouring to make Samuel Jackson, a messenger at the telegraph office, disclose the contents of a foreign telegraphic message. Mr. Evered Salmon, on behalf of the Treasury, was prosecuting Sidney F. Bees, an absconding bankrupt, who had been traced to Ceylon, and, through the chief constable, Mr. Salmon had forwarded a telegram to the Ceylon police on May 18 for his apprehension. On May 20 prisoner called and offered to supply him with Bees' address. He showed him the address on the telegram he had two days before sent to Ceylon. Questioning Hill, he learned that he had obtained it from Jackson, a telegraph boy. Jackson, who lodged with Hill, deposed that Hill had told him he should have something if he could procure it, and, seeing the foreign message in transit in the instrument-room, he got another boy to copy it, and handed it to the prisoner, who was unaware that it was Mr. Salmon's own message. Mr. Salmon thereupon communicated with the authorities. Hill was committed for trial.

Theory of the Galvanic Couple.—The *Journal of the Chemical Society* for June contains an abstract of a paper by Herr F. Exner, read before the Academy of Vienna, in which he endeavoured to show that the contact theory should be replaced by a chemical one. He stated that it was a well-known fact that a chemical reaction takes place between two substances with evolution of heat when the potential chemical energy of the components is greater than that of the products, and the heat evolved is the equivalent of the energy lost. For example, the arrangement $Zn + H_2O$ represents a greater potential energy than $Zn + OH_2$, and the result is the decomposition of the water by the zinc, with evolution of heat. Similarly the potential energy of $Zn + CuSO$ is greater than that of the products of the reaction $ZnSO_4 + Cu$, &c., and the energy lost in the reaction will appear according to the arrangement of the experiment either as heat or electricity. When zinc dissolves in water the chemical energy which is lost reappears as positive and negative electricity, and when a maximum is reached these reunite and appear in the form of heat.

Iridium for Electric Lamps.—The *Cincinnati Commercial* says:—"There are over five hundred men in this city studying and making experiments with electricity with a special view of utilising it as a light. The experiments made with iridium by John Holland, of this city, have culminated in a discovery that secures that indestructible material, iridium, for use as a burner for the electric light. He has a piece of iridium weighing only seven-and-a-half pennyweights, burning, with a Maxim machine, about two weeks of ten hours per day, and there is no perceptible change in the metal either in its structure or its chemical character. From all appearances it looks as though it would last a year. A burner of that size can be furnished at not to exceed eight dollars. The light is pure white, and steady. The focus is fixed, and no poisonous gases are emitted as from carbons. It is used for the negative, or under burner, thus far, but experiments encourage the hope that it can be used for both poles or burners. The iridium burner will be used on one of the lamps of the Florentine this week, so that the public can see it in operation and in comparison with the carbon burners now in use."

Influence of Pressure on the Conductivity of Wires.—The influence of pressure on the electric conductivity of metal wires has been studied anew by M. Chwolson (*Imp. Acad. of St. Petersburg Bulletin*, March), Wartmann's previous experiments, in which wires were compressed between steel plates with caoutchouc lining, having failed to

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show whether pressure changes the *specific* resistance. M. Chwolson used a piezometer, giving pressures up to 60 atmospheres, the wire being wound round a glass tube, then passed through it, and the tube inserted in another, which was connected with the piezometer (the two wire ends were brought out through binding screws). Among other results, at 3·8° C. the copper wire showed a relative diminution of resistance of about 0·0000013 by one atmosphere of pressure; a hard brass wire about 0·0000011; and a lead wire (at 7° C.) about 0·000011, or ten times more than the brass. Pressing at 17° C. the calorific action preponderates over the direct action of pressure for copper and brass, while the reverse occurs with lead. Moreover, the author proves, in the case of the brass wire, that the pressure causes change of the specific resistance besides change of the resistance through change of the length and thickness. Every relative change of volume involves a relative change of the specific resistance about 3·6 times as great.—*Nature.*

The Experiments with the Electric Light at the Pleasley Colliery.—The apparatus used consisted of a Bürgen machine wound for driving forty-eight lights and a Gramme machine for twenty-four lights. A number of Swan lamps were fitted with wooden sconces in the road and gateways, and a specially designed lamp was used at the workings. This lamp can be used in any position at or near the surface of the coal, and burns as well sideways or upside down as in its normal state. The Pleasley Colliery is worked on the "long wall system." The pit is about 580 yards deep. The length of cable to the most distant stall was about 1,300 yards, or with the return wire 2,600 yards. When working twenty-four lamps parallel the total resistance of leads and lamps was about 3·6 ohms, of which 1·6 ohms, or about 45 per cent., is in the lamps. When forty-eight lamps are worked in three series of sixteen each the total resistance was about 9·5 ohms, of which 7·5 ohms or 78 per cent. was due to the lamps. This seems to indicate the economy of working several lamps in series when the resistance of the leads is somewhat high. The former arrangement was used in connection with the Gramme, the latter with the Bürgen machine. The light of the Swan lamps varied from about 18 to 25 candles, those in the movable lanterns being smaller than those in the main roads and gates. The colliers expressed their pleasure in obtaining such a light. The Commissioners were testing the system from the Wednesday to the Friday, and tried a number of experiments, so as to ascertain the value of the system under every conceivable condition. It was found that two men could work well together using one lamp of 15 candles, but it was also found that under other conditions it would be better to have the men working separately and use a smaller light. We have referred to these experiments elsewhere, and further information relating to the special lamp is promised, which we hope to obtain and give shortly.

Static Electricity as a Therapeutic Agent.—We are sufficiently familiar (says the *British Medical Journal*) with the therapeutic uses of the galvanic and faradic currents, and have constant opportunities of verifying their value in the diagnosis and treatment of various diseases of the nervous system; but, for some reason, the form of electricity which is best known to the public, that produced by the ordinary electrical machine, has had little attention paid to its possible uses in medicine. Most authorities, including Duchenne, Remak, Benedikt, and Onimus, have attached very little importance to it; and it is owing mainly to the zeal of M. Vigouroux and the enthusiasm of M. Charcot, that it has been rescued from the oblivion into which it had fallen. In a recent lecture, M. Charcot has pointed out that the essential differences between the various forms of electricity are differences of quantity and tension; and that, while the ordinary galvanic battery supplies a current, large in amount, but of low tension, the current of the electrical machine is quantitatively small, but of high tension; and the faradic or induced current occupies an intermediate position in both respects. These differences correspond to diverse physical and physiological qualities possessed by these currents; thus, for example, at a given time after the section of its nerve, a muscle no longer responds to faradism, while the galvanic current acts more energetically than in the normal state; and doubtless where there are these physiological differences, there are also special therapeutic capabilities for each. The machine used at the Salpêtrière is one of Carré's. It is always kept under a bell-jar with some water-absorbing substance, such as chloride of lime, so as to be dry and ready for use in all weathers, and is so arranged that five or six patients can be operated on at once. One pole of the battery is connected with an insulated stool, on which the patient sits, while the other pole is connected with the earth; the patient thus sits, as M. Charcot describes it, in an electrical bath. But the electricity in the patient is by no means quiescent; it escapes especially at every projecting portion of his body or dress, and there result from this various peculiar sensations, such as tingling over the whole body, cobwebs brushed across the face, wind blowing on the extremities; in addition, the cutaneous perspiration is increased, and digestion and appetite are stimulated. By means of instruments called excitors, the discharge of the current may be localised in any desired part of the body. These excitors are pieces of metal with pointed or bulbous extremities, connected with the earth by a chain, and having insulated handles. When brought about six or eight inches from the skin of a patient, this instrument excites a sensation of blowing, called the "electrical wind." As near as two or three inches it causes a feeling of prickling, and a pencil of luminous rays passes from the point of the excitor, and broadens out as it nears the skin; this M. Charcot calls the aigrette. Still nearer to the body it produces a spark, accompanied by the sensation of a puncture; while, if a muscle be subjacent, it is thrown into contraction, and in this manner localised muscular electrisation may be effected; and, in certain cases of spinal paralysis, M. Charcot has succeeded by this means in producing contraction of muscles, which had resisted the action of the faradic current. He has succeeded, by means of the "electrical wind," in curing hysterical hemianæsthesia; he has seen great benefit result in cases of peripheral facial paralysis; he was able, by means of the electrical wind and spark, to stop momentarily the tremor in one case of paralysis agitans, and, in several other cases, to obtain benefit. Moreover, certain cases of spinal irritation, dyspepsia, and dysmenorrhœa, which had resisted other remedies, were ameliorated by the aid of statical electricity. The *New York Medical Record* has recently contained some interesting papers on static electricity by Dr. W. J. Morton, who has been an eye-witness of the experiments at the Salpêtrière, and, since his return to America, has been making use of it. He gives notes of twelve cases in which this remedy was used, amongst which are a case of locomotor ataxy, a case of pressure paralysis of the arm, a case of Bell's paralysis, and one of severe sciatica, all of which were cured. Although some reserve is prudent in accepting all the alleged results of static electricity, enough has been shown to revive our interest in it as a therapeutic agent, and to make us hope to see it withdrawn from the undeserved neglect into which it has sunk in this country.

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THE TELEGRAPHISTS AND POST OFFICE SORTING CLERKS.

On Saturday, June 18, there was published the report of the Postmaster-General to the Treasury, dated June 13, 1881, proposing certain improvements in the pay and regulations of the sorting clerks and of the telegraphists of the Post Office; and the Treasury reply thereto, dated June 16, 1881.

In his letter to the Treasury Mr. Fawcett lays before their lordships the measures which he considers necessary for improving the pay and the general position of the telegraphists and sorting clerks employed by the Post Office. He says:—

"As you are no doubt aware, widespread discontent has for some time past manifested itself in the telegraph service, and although the postal staff have, to their credit, refrained from associating themselves with any public demonstration of dissatisfaction, the numerous memorials which have reached me are evidence of the existence among them of a similar state of feeling.

The principal complaints from both branches of the service are—

(1) Inadequacy of pay, arising to some extent from stagnation in promotion.

(2) The excessive amount of overtime, the small rate of pay allowed for it, and the severity of night duty.

(3) The insufficiency of the amount of yearly holiday.

(4) The deductions made from pay during absence from sickness.

(5) The absence in the case of the provincial staff of extra payment, as made partially in London, for work performed on Sundays, and as regards the telegraphists at the central office, for work performed on Christmas Day and Good Friday."

The Postmaster-General continues:—

"For several months past I have been collecting information from all sources, not only as to the alleged grievances of the staff, but as to the conditions of service and rates of pay of persons in private employment whose duties seem most nearly to correspond to theirs. The whole question has been examined at conferences of the Post Office surveyors, who have unanimously come to the conclusion that substantial grievances calling for remedy exist, and who put forward proposals for that object. I have most carefully considered all the evidence which has been obtained, including the statement made to me by the representatives of the telegraphists at a lengthened interview, and other statements subsequently submitted by them in writing. I have also on several occasions discussed the whole question with many of the practical officers of the department, and it is evident to me that, while no such comparatively high rate of pay as that afforded by the Playfair Scale, Lower Division, is warranted, the time has come when some general improvement must be made in the position and prospects of the telegraphists and sorting clerks.

"The measures which, in my judgment, are necessary in order to remove all well-founded grievances, and to place these branches of the service in all respects upon a satisfactory footing, are as follows, viz.: 1. That a simpler classification be adopted, based upon the intelligible principle of paying for work solely according to its quality; that, accordingly, such improved classification be effected by substituting for the present very numerous scales and classes for telegraphists and sorting clerks five scales applicable to the male staff and five applicable to the female staff. The first scale would be paid where duties of the highest quality have to be performed; the number of places in the class carrying the scale being regulated strictly in accordance with the aggregate number of such duties, and promotion to it being determined invariably by the selection of the best qualified. Duties of high quality, but not of the highest quality, would be paid for at the second scale, while duties of lower quality would be paid for at the third, fourth, or fifth scales, according to their degree. The new classification will affect promotion as well as present pay; for it is obvious that, the more numerous are the classes, the more numerous also are the chances of being stopped in each class by the want of vacanies in the one next above it; whereas in a single enlarged class there is no stoppage between its minimum and maximum. 2. That adjustment be made, where necessary, of the pay of officers, such as superintendents and assistant-superintendents, ranking above the general body of telegraphists and sorting clerks, with due regard to the higher rates of pay proposed to be given to the staff below them. 3. That all future entrants into the service, whether intended ultimately to be telegraph or sorting clerks, including under the latter designation sorters, be instructed in the elementary work of both branches; so that, in case of emergency in either branch, additional help may be obtained from the other. 4. That so far as may prove advantageous to the service, a plan already in operation at several offices of amalgamating the postal and telegraph staff be extended. 5. That the period of ordinary night attendance, both for telegraphists and sorting clerks, be reduced from eight to seven hours, already recognised at several offices as the proper amount of night attendance for the postal staff. 6. That payment for ordinary overtime work at provincial offices, whether of telegraphists or sorting clerks, be in the case of male officers at the rate of one-fiftieth part of a week's pay per hour; and in the case of female officers (who as a rule are not called upon to do more than forty-eight hours' work per week) at the rate of one forty-eighth part of a week's pay. That when the overtime work at any given office on a single occasion exceeds three hours, the rate of pay for such excess shall be one-quarter higher than the ordinary rate. As a rule the sixteen hours, which form an officer's work for two days, shall be so divided as to avoid giving him more than eleven hours' work on either day; when an occasional exception is necessary, all excess beyond eleven hours on any one day shall be paid for as overtime, although the two days' work in the aggregate may not exceed sixteen hours. 7. That payment, as for overtime work, be given for all Sunday work performed by the indoor staff, whether telegraph or postal, which, in a month of four Sundays, may be in excess of eight hours; *i.e.*, an average of two hours per Sunday. 8. That payment, as for overtime work, be given for all work done on Christmas Day and Good Friday, whether by the indoor staff or outdoor staff, and telegraph as well as postal. 9. That the allowances to telegraphists for subsistence when absent from head-quarters on official business be assimilated to the corresponding allowances for the postal staff, which are at a somewhat higher rate. I do not include in the present letter any detail of the changes necessary to be made in the classification and scales of pay for the sorting force in London; but memorials from members of that force have been received, and it will be obvious that they cannot be excluded from any improvement of position which may be conceded to the telegraphists and provincial sorting clerks. Accordingly the estimate of cost given in the present letter provides approximately for the sorting force in London as well as for others. At the interview the telegraphists had with me great stress was laid on the fact that at one office they received a larger proportion of their pay when absent ill than they did at another. Until nine years ago, except at two or three offices where a special regulation existed, a sorter or sorting clerk during absence from illness received only the difference, if any, between his own pay and the pay of his substitute, and if there was no difference he received nothing at all. A regulation was then established to the effect that such officers throughout the kingdom, when absent ill, were to receive half-pay. If he belonged to one of the two or three offices where a special regulation existed he was to reap the advantages of that regulation still; and if out of his pay, after payment of his substitute, a difference of more than one-half remained he was to receive the difference, but in all other cases whatsoever the allowance during absence from illness was to be half-pay. This regulation at the time it was established was accepted as a great boon, and I am not prepared to extend it.

"As regards the question of annual leave of absence, I am now considering a scheme, the effect of which I hope may be to give one month's leave in the course of the year to many who now have only three weeks, and to give three weeks to many who now have only a fortnight.

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"Should your lordships approve of the several measures proposed, arrangements can be adopted without delay for giving effect to those relating to payment for overtime work, to work done on Sundays, Good Fridays, and Christmas Day, and to subsistance allowances; but a considerable time must necessarily elapse before the new scheme of classification and scales of pay can be applied definitely to every office.

"I recommend that a common date be fixed for giving effect to the readjustment of each such establishment, so that all officers may be treated alike, and I think it advisable that the date thus to be fixed should be the commencement of the present financial year, viz., the 1st of April last. Under such an arrangement every officer benefiting by the measure would receive at once the difference between his present pay and that yielded by the readjustment of the establishment of his office, for the period elapsing between the 1st of April and the date of the authority for the readjustment."

The immediate increase of expense would be about sixty-seven thousand eight hundred and eighty-three pounds (£67,883) a year, viz.:—£29,481 on postal, and £38,402 on telegraph account. I cannot, of course, but admit that the recommendation which I make involves a serious increase of expenditure. The expenditure, however, must necessarily be large which is designed to improve the condition of so large a body of public servants as those whose case is now under examination, numbering in all more than 10,000; and feeling convinced that the rates of pay which I propose are not more than sufficient to afford just and reasonable remuneration to those on whose efficiency and contented service so much of the interests and convenience of the community depend, I confidently submit the scheme for your lordships' approval. I shall have subsequently to ask your authority, either in the shape of schedules or in some other convenient form, for the details of an adjusted establishment for each office upon the lines of the present scheme.

The following classifications are attached to Mr. Fawcett's letter in the form of schedules:—

Present Scales of Weekly Wages for Provincial Male Telegraphists.—At offices with three classes: First-class, 36s., by 2s., to 44s.; second class, 28s., by 1s. 6d., to 35s.; third class, 12s., 14s., 16s., by 1s. 6d., to 27s. At offices with two classes: First class, 28s., by 1s. 6d., to 35s.; second class (usually), 12s., 14s., 16s., by 1s. 6d., to 27s.; or, first class, 22s., by 1s., to 27s.; second class, 14s., by 1s., to 21s. At offices with one class: 12s., 14s., 16s., by 1s. 6d., to 27s.; or 14s., by 1s., to 21s.; or 16s. by 1s., to 20s. The two last scales are being gradually superseded by the scale 12s., 14s., 16s., by 1s. 6d., to 27s. a week.

Present Scales of Weekly Wages for Provincial Female Telegraphists.—At the larger offices, where female telegraphists are employed, they are formed into two classes, the scale for the higher class rising from 22s., by 1s., to 27s. a week, and from the lower class, from 10s., 12s., by 1s., to 21s. a week. Elsewhere female telegraphists are on one class, rising from 10s., 12s., by 1s., to 21s. a week.

Present Scales of Weekly Wages for Provincial Sorting Clerks.—At offices with four classes: First class, 37s., by 2s., to 44s.; second class, 29s., by 2s., to 36s.; third class, 23s., by 1s. 6d. to 28s.; fourth class, 18s., by 1s. 6d., to 22s. (this is a small class of youths, and it is not intended that any officer should ever remain long in this class after reaching the maximum). At offices with two classes: First class, 27s., by 1s. 6d., to 35s.; second class, 18s., by 1s. 6d., to 25s.; or, second class, 20s., by 1s. 6d., to 26s.; or, second class, 20s., by 1s., to 27s.; or, first class, 26s., by 1s. 6d., to 33s.; second class, 20s., by 1s., to 25s.; or, second class, 18s., by 1s. 6d., to 25s. At offices with one class: 20s., by 1s., to 24s., then 1s. 6d., to 33s.; or 18s., by 1s. 6d., to 33s., (one or more clerks rising to 35s. or 36s. a week). Or 20s., by 1s., to 30s.; or 18s., by 1s. 6d., to 30s. (one or more clerks rising to 33s. a week). Or, in the case of a few offices in Ireland and Scotland, 16s., by 1s., to 26s., or 18s., by 1s., to 28s. Note.—The last-mentioned scales are being gradually replaced by one rising to 30s. a week.

Proposed Scheme of Classification for Telegraphists and Sorting Clerks at Provincial Post-offices.

For men.—1st class: 40s., by 2s., to 50s. a week; 2nd class: 12s., 14s., 16s., by 1s. 6d., to 38s.; 3rd class: 12s., 14s., 16s., by 1s. 6d., to 36s.; 4th class: 12s., 14s., 16s., by 1s. 6d., to 33s.; 5th class: 12s., 14s., 16s., by 1s. 6d., to 30s.

For women.—First class, 27s., by 1s. 6d., to 32s.; second class, 10s., 12s., by 1s., to 17s., then 1s. 6d., to 26s. a week; third class, 10s., 12s., by 1s., to 17s., then 1s. 6d., to 25s.; fourth class, 10s., 12s., by 1s., to 17s., then 1s. 6d., to 24s.; fifth class, 10s., 12s., by 1s., to 17s., then 1s. 6d. to 23s. Note.—At offices at which supervising duties devolve on clerks below the first class, allowances ranging from 2s. to 5s. a week to be granted where necessary.

CENTRAL TELEGRAPH OFFICE.

Male Telegraphists.—Present: Senior, £100, by £5 to £160 a year; first class, £100, by £5 to £130 a year; second class, £70, by £5 to £90 a year; third class, 12s., 14s., 16s.—£45, by £5 to £65 a year. Proposed: Senior, £150, by £8 to £190 a year; first class, £110, by £6 to £140 a year; second class, 12s., 14s., 16s.—£45, by £5 to £100 a year.

Female Telegraphists.—Present: First class, 25s., by 1s. 6d. to 30s. a week; second class, 18s. by 1s. 6d. to 24s. a week; third class, 8s., 12s., 14., by 1s. to 17s. a week. Proposed: First class, 28s. by 1s. 6d. to 34s. a week; second class, 10s., 12s., 14s., by 1s. to 27s. a week, and 1s. 6d. to 27s. a week.

METROPOLITAN DISTRICT.

Male Telegraphists.—Present: First class, £100, by £5 to £130 a year; second class, £70, by £5 to £90 a year; third class, 12s., 14s., 16s., £15, by £5 to £65 a year. Proposed: First class, £110, by £6 to £140 a year; second class, 12s., 14s., 16s., £45, by £5 to £100 a year.

Female Telegraphists.—Present: First class, 25s., by 1s. 6d. to 30s. a week; second class, 18s. by 1s. 6d. to 24s. a week; third class, 8s., 12s., 14s., by 1s. to 17s. a week. Proposed: First class, 28s., by 1s. 6d. to 34s. a week; second class, 10s., 12s., 14s., by 1s. to 27s. a week, and 1s. 6d. to 27s. a week.

"The Secretary to the Treasury to the Postmaster-General.

"Treasury Chambers, July 16, 1881.

"SIR: In reply to your letter of the 13th inst., following several personal conferences between yourself and representatives of the Treasury, with the assistance of officers from your own department, I am directed by my Lords to state that they accept the proposals which you submit to them in that letter for improving the pay and general position of the telegraphists and the sorting clerks employed in the service of the Post Office in London and in the country, with the understanding that effect is to be given to the new classification and to the new scale of wages from the 1st April, 1881, as fast as they can, with due consideration, be applied to the several offices. These proposals include—

"1. A new classification and scale of wages, which is to be uniform for the postal staff of the sorting branch and for the telegraphists, involving an increased immediate charge of nearly £44,000, and an increased average charge of £128,000 per annum, as soon as the new rates advance to their normal limits.

"2. The cost of the reduction of night attendance to seven hours, involving an increase of more than £9,000 per annum.

"3. Improvements in the rate of payment for overtime, and particularly in respect of allowing it on Sundays, Christmas Day, and Good Friday, involving an increase of more than £15,000 per annum.

"The joint effect, therefore, of these measures is to increase the cost of the postal and telegraph service at once by £67,000, and prospectively by £152,000 (on an average) per annum.

"The amount of this increase of the public charge is quite sufficient of itself to explain the hesitation which my Lords have felt in consenting to it; nor can they shut their eyes to the means by which the claims for this improvement in the terms of service have been urged upon the Government by a part of the officers interested.

"Admitting, as my Lords do, that when discontent is shown to prevail extensively in any branch of the public service, it calls for attention and inquiry, and, so far as it is proved to be well founded, for redress, they are not prepared to acquiesce in any organised agitation which openly seeks to bring its extensive voting power to bear on the House of Commons against the Executive Government responsible for conducting in detail the administration of the country. The persons who are affected by the changes now proposed are, as you observe, no fewer than 10,000, and the entire postal

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service numbers nearly five times as many. Other branches of the Civil Service employed (and voting) in various parts of the United Kingdom, are, at least, as numerous in the aggregate as the servants of the Post Office. All this vast number of persons, not living like soldiers and sailors outside ordinary civil life, are individually and collectively interested in using their votes to increase, in their own favour, the public expenditure, which the rest of the community, who have to gain their living in the unrestricted competition of the open market, must provide by taxation, if it is provided at all.

"My Lords, therefore, reserve to themselves the power of directing that the execution of the terms agreed to in the preceding part of this letter be suspended in any post-office of which the members are henceforth known to be taking part in extra-official agitation.

"They understand that you are inquiring whether the law, as declared in the existing Post Office Acts, does not afford to the public similar protection in respect of postal communication, including telegraphs, as is afforded by the Act 38 and 39 Vic., cap. 86, sec. 4, to municipal authorities and their contractors, against breaches of contracts of service in respect of gas or water, the wilful interruption to the use of which is hardly of more serious import to the local community than is that of postal communication to the national community.

"If the existing Post Office Acts do not meet this case, it will be for my Lords to consider whether the circumstances continue to be such as to make it their duty to propose to Parliament an extension to the Post Office of provisions similar to those cited above from the Act 38 and 39 Vic., cap. 86.

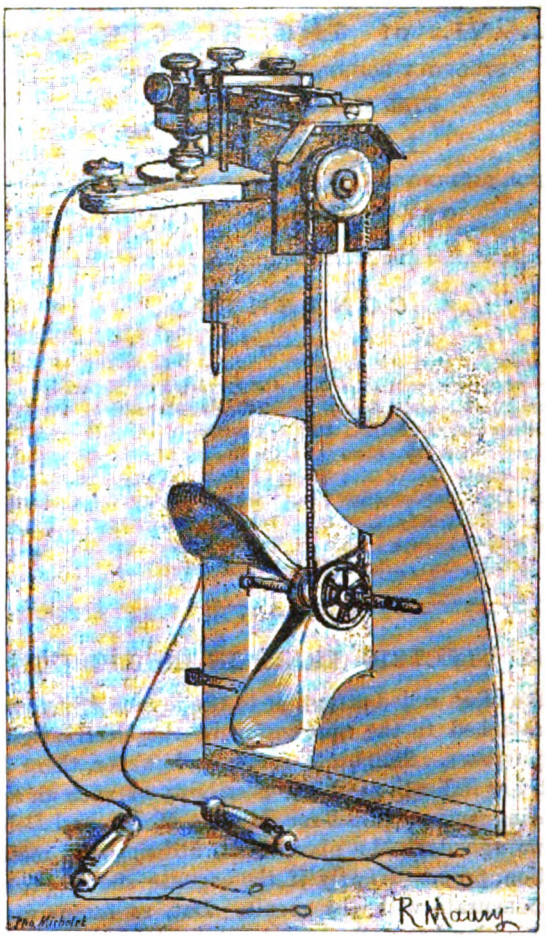
"In conclusion, my Lords desire me to add that they entirely agree with you in the opinion that the great body of telegraphists are simply misled in being encouraged to contend that, because the Telegraph Act of 1868 (30 and 31 Vic., cap. 110, sec. 8 (7) has declared that such of them as were transferred from the service of the telegraph companies to that of the Postmaster-General should be 'deemed to be, to all intents and purposes, officers and clerks in the permanent Civil Service of the Crown, and should be entitled to the same, but to no other privileges,' therefore, they became entitled to be paid in conformity with what is generally known as the Playfair Scale, Lower Division, rather than with any other of the numerous scales which are shown in the estimates annually submitted to Parliament for the salaries of the many thousands of persons who are, equally with these telegraphists, 'to all intents and purposes, officers and clerks in the permanent Civil Service of the Crown.' The Playfair Scale, as it is called, includes but a very small part of the scales which are to be found in those estimates, nor have the telegraphists the shadow of a legal right to claim it as peculiarly applicable to themselves.—Yours, &c.,

"F. CAVENDISH.

"The Right Hon. Henry Fawcett, M.P."

PROPULSION OF BOATS BY ELECTRICITY.

In April last, M. Trouvé, the well-known electrician of Paris, successfully propelled a tricycle weighing about 55 kilogrammes, and together with its rider, 160 kilogrammes, by means of two of his electric motors, at a speed equal to that of an ordinary cab. Encouraged by his success on *terra firma*, he has since turned his attention to the propulsion of boats by the same means. On the 26th of May he made his first experiment on the Seine in Paris. He used one of his electric motors, which was fixed to the top of the rudder of an ordinary pleasure boat, as shown in the figure.* The little pulley wheel was connected with another wheel on the shaft of a three bladed screw, fitted into a hollow cut in the rudder. The motor was so fixed to the top of the rudder that it did not interfere with the steering of the boat, and with its accessories did not weigh more than 5 kilogrammes. The boat, which was named the "Telephone," was about 5·50 metres long by 1·20 metres wide, and weighed some 80 kilogrammes. The battery, which consisted of two series of six Wollaston cells weighing 24 kilogrammes in all, was placed in the middle of the boat, and was connected with the motor by means of wires, insulated so as to likewise serve as tiller ropes; they were also provided with handles, by means of which the current could be cut off, or not, at will. The boat, with three persons in it, ascended the Seine for a measured distance of 200 metres, at a speed of 1·50 metres per second, or 5,400 metres per hour, the velocity of the current of the Seine near the bank being estimated at 20 centimetres per second, and descended the same distance at a speed of 2·50 metres per second. *La Nature*, speaking of these experiments of M. Trouvé, recalls to mind a similar experiment made by Jacobi on the Neva, so far back as 1839. He used two Grove batteries, each comprised of 64 zinc and platinum couples, and having together a superficies of 32 square feet. The current obtained was so powerful as to at once heat to incandescence a platinum wire two metres long, and of the thickness of pianoforte wire. The gas given off by this battery, however, was so powerful as to seriously incommode the experimenters, and even to affect spectators on the banks of the river. The boat was driven by paddle wheels, and with twelve people inside her, ascended the Neva against stream, and also against a strong wind which happened to be blowing. We are not told what speed was attained, however.



Those of our readers who may happen to be present at the forthcoming electrical exhibition in Paris will have an opportunity of seeing M. Trouvé's boat, and judging of its performances for themselves, as it is intended to exhibit it in a small pond. Meantime, we wish the owner of the "Telephone" all success in his experiments, which we believe he is still continuing.

A M. Cloris Baudet has also experimented successfully with a small boat 7 metres long, and a battery and motor of his own construction. He states that this battery worked for five hours, and was still very powerful at the end of that period. After making some slight modifications in his apparatus he intends to continue his experiments on the Seine. We believe that a very small boat propelled by electricity is to form one of the attractions of the Palais Royal Gardens during the concerts to be given there during the next three months. The boat will be "manned" by a little girl.

We may remark here that M. Gaston Tissandier is about to make an attempt to propel a small balloon by means of one of Planté's secondary batteries, and a Trouvé motor. This will also be on view at the Exhibition.

* We are indebted for this illustration to our contemporary, *L'Electricité*.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice watever will be taken of anonymous communications.*

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THE ELECTRIC LIGHT IN COLLIERIES.

We have often called attention to the immense importance that is attached to the application of the electric light to mining purposes. Till quite recently, however, there have been but few indications of the possibility of such an application being successful. True, Messrs. Molera and Cebrian some time ago devised a plan which, utilising the methods of reflection, promised fairly if the expense should prove at all commensurate with the result. But, so far as we can gather, this plan has never been tried in practice, so that its capabilities are still undetermined. It has been well known to many that for some time past Mr. R. E. Crompton has been experimenting in this direction, using the Swan lamp as the basis of the illuminating system. These experiments have so far proved successful that under the auspices of the Mines Accidents Commissioners a practical experiment on a large scale has been carried out at the Pleasley Colliery. The work has been closely scrutinised and carefully examined in every detail by the Commissioners, whose report will be received with great interest. Besides the Commissioners some 250 engineers and colliery proprietors witnessed many of the experiments, and among the scientific men present we may mention Professors Abel, Clifton, Tyndall, Messrs. Lindsay, Lewis, Warrington, Smyth, Wood, T. Burt, M.P.; Mr. T. Evans, Inspector of Mines, &c. Unfortunately, Mr. Crompton, through an attack of illness, was not present to witness the great success of his plans.

As we state, the Commissioners were thorough in their investigation. The lights were kept going pretty continuously from Wednesday afternoon until Friday night—a length of time sufficient to fairly test the system. The apparatus used consisted of one of the new Bürgin dynamo machines built by Mr. Crompton for supplying a current for 48 lights, a Gramme machine to supply the current for 24 lights, and the Swan lamps. A number of the lamps were fitted into wooden holders in the main roads and gates, whilst a number of miners' lamps of a special design were also used. These miners' lamps are so constructed that they may be overturned, thrown down, or knocked about considerably without much danger of damage to the slender carbon filament which is rendered incandescent. The outer case of this lamp is air-tight, and it is stated that between the outer case and the fragile globe of the lamp proper is a sufficient quantity of air to suffice for the instantaneous combustion of the carbon filament should the inner bulb be shattered by an explosion.

We are not sure that we thoroughly comprehend or agree with the argument that this double enclosure of the carbon filament secures safety from explosion. Is it quite certain that the inner globe will be broken first, and time allowed for the combustion of the carbon? If the outer globe is broken while the inner remains intact there is no danger, and if the inner is broken for a short but perceptible period of time before the outer there would still be no danger, but if the breakage of both glass globes happens instantaneously it seems to us that any external gas would be brought into contact with the white hot carbon, that is, with matter at a sufficiently high temperature to explode most explosive gaseous mixtures.

The great question, then, seems to resolve itself into this: Is it possible to obtain perfect immunity from explosion by any system in fiery mines? Let us by all means continue to try and obtain such a system if the answer be affirmative, but if the answer be negative then we have to consider the comparative values of the various systems presented to us. The system presented by Mr. Crompton in these experiments will, no doubt, undergo many modifications before it has reached the stage when further improvement is impossible, but it is already imperative to know how it compares with the systems in use. The only point for discussion is its safety. There is no doubt about the light being better and handier. The precautions taken to insure that no metallic contact shall take place between two points of the conductors are in the right direction, the arrangement being such that the return wire is taken through another shaft, but this precaution is insufficient if the conductor be not so placed that the probability of electrical contact is almost infinite.

The extra light given by the system under consideration is much appreciated by the men engaged in the work, inasmuch as it allows the coal to be picked over at once so much cleaner, lessening the carriage of waste material to the pit's mouth. The light can be cast well under the coal when the men are "holing," far better, indeed, than by the use of a "clanny" or other safety lamp. It allows, too, of the better surveying the actual state of the mine, and especially so in the case of bad and dangerous roofs, that most fatal cause of accidents, while there can be no discussion as to its facilitating locomotion. Considering the combination of good features, it may be said that Mr. Crompton and his associates have given us a system quite equal to existing systems as regards safety, and superior as regards utility.

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THE STORAGE OF ELECTRICITY.

The invention of the Faure "secondary battery," and its projected application to electric lighting and motive power, have suddenly raised this class of electric apparatus into public note. Some account, therefore, of what had been already done in this department may not be out of place.

The germ of the secondary battery consisted in an observation made by Gautherot in the first year of this century. While Gautherot was experimenting with the new voltaic "pile," he observed that, when the platinum wire electrodes connected to the poles of the pile were immersed in water containing a little salammoniac, they yielded up a brief current in the reverse direction, when the current from the pile had been cut off. Two years later a German physicist, named Ritter, noticed the same effect with gold electrodes; but he made a distinct advance by actually constructing a battery for rendering back these "polarisation currents," as they are called. This device of Ritter's was the first of all secondary batteries. The germ of Gautherot was fertilised by the genius of Ritter, and became the first parent of Faure's accumulator. In those days there were fewer patents taken out, and pure science was less the slave of greed than it is now; so Ritter died in poverty, an end which was accelerated by his loose living.

Ritter's theory of the secondary action was that the electricity soaked its way into the surfaces of the plates, or accumulated in the layers of liquid lying next the plates; but Volta, Marianiani, and Becquerel showed clearly that it arose from the couch of liberated salts or gases which formed on the plates. In the case of metal plates plunged in water the current in passing from one plate to the other decomposed the water into its constituent gases, and oxygen was deposited on the plate where the positive current entered, while hydrogen was deposited on the plate where the current left the cell. When the current was cut off, these two couches of liberated gas, being of opposite electric condition, the hydrogen positive to the oxygen, tended to set up a current betwixt them, and when the plates were connected by a wire a current was established in the latter contrary in direction to the original charging current. Electricity then was stored up in the liberated gases, positive in one couch, negative in the other, and it could be recovered from them by connecting the metal plates together. These plates being of the same metal could render no such current while free from the liberated gases, but the gaseous layer deposited on each altered the electric relations to one another, and made them operate like plates of different metals in the ordinary voltaic cell.

This fact was practically demonstrated by Grove, who in 1843 constructed what is known as a "gas battery." In this contrivance the plates are both of the same metal, platinum, but one is surrounded by oxygen gas and the other by hydrogen gas. When the plates are connected by a wire a current flows from the hydrogen plate to the oxygen plate, and its electromotive force depends on the degree to which hydrogen as a substance is positive to oxygen. The platinum plates, in fact, only serve the purpose of broad connections, making a roomy contact with the gases, which are the real electro-motors.

The secondary current yielded by these two gases is, however, feeble, and an accumulator formed of platinum plates immersed in water would not be practicable for producing large effects, such as are required in electric lighting or motive power. It remained, therefore, to discover a combination which would intensify the effects. Not merely gases deposited on the plates, but also salts and acids yield the reactionary current, and it was in this direction that the best hope of success appeared to lie. Curiously enough, though Ritter obtained these currents from electrodes of platinum, silver, iron, and so on, he failed to get them when he employed lead plates, the very things which, in the hands of Planté and Camille Faure, three-quarters of a century later, were to prove so valuable. His failure was probably due to the fact of his using solutious of chlorides for the liquid, and thereby creating chloride of lead in the passage of the current. Being a nonconductor, chloride of lead would stop the current.

An important advance was made by M. Gaston Planté, of Paris, in 1859, when he discovered that sheets of lead separated by canvas, and immersed in water, tinctured with sulphuric acid, yielded very marked polarisation currents. Planté constructed a large battery of this kind, the two plates being rolled up together for compactness, and plunged into a cylindrical jar containing the dilute acid. These cells improved with use, owing to the lead acquiring a spongy texture as it was attacked by the gases, and brown peroxide of lead was deposited on the plate at which the oxygen was liberated. Their internal resistance was only 1-8th to 1-20th of an ohm, and they were capable of storing up great quantities of electricity. The distinctive merit of the secondary battery does not, however, consist in the mere fact of accumulating or storing electricity, but in the manner of the storage. Electricity can be accumulated in the ordinary telegraphic condenser and kept for any reasonable length of time; but when it is required for use it can only be obtained in a single momentary flash or spark. In the secondary battery the discharge takes place gradually. It is not a sudden spark but a slow continuous current. In the condenser the opposed electricities are lying free upon the surface of the metal plates, and ready to combine instantaneously, whereas in the secondary battery they are garnered up in the form of chemical work, and can only be released by a process of chemical change, the reverse of that by which they were created. In the Planté cell the electrode by which the charging current enters becomes peroxidised, while the plate by which it leaves is deoxidised. When the charging current is cut off, the discharging current is ready to start in an opposite direction through the cell from the deoxidised to the peroxidised plate, and so on through the external circuit from the plate by which the charging current flowed in to the plate by which it flowed out. In brief, the secondary or discharging current is opposite in direction to the primary or charging current.

Planté's battery produced very powerful experimental effects; but it was still too weak for industrial purposes. As everybody knows, however, it has recently been improved by M. Faure, who acted on the hint afforded by the deposit of brown peroxide of lead on the oxygenated plate. The peroxide, however, takes a considerable time to form from the plates themselves, and M. Faure conceived the happy idea of supplying to the plates a lower oxide which could readily be oxidised into the higher peroxide. He, therefore, surrounded the plates with red-lead or minium, and sheathed them in felt, then rolled them together as in the Planté cell, and plunged them in dilute sulphuric acid. The result was a secondary battery, which is claimed to have a capacity for electricity forty times that of the original Planté; but this figure is probably overstated. Further trials are necessary to confirm it.

These secondary batteries are not the only ones which have been devised in recent years. Professors Houston and Thomson, of Philadelphia, have constructed one of two copper plates immersed in sulphate of zinc. When the charging current passes zinc is deposited on one plate, and thus a Daniell cell is formed. M. D'Arsonval also employed a lead together with a zinc plate immersed in sulphate of zinc, and metallic zinc was deposited on the zinc and oxygen was deposited on the lead, which thereby became partially decomposed into brown peroxide of lead. Mr. Varley employed carbon for the plates of a voltameter or secondary battery to give time signals, and last year M. Sauvage Henri, Principal of Telegraphs at Evreux, found this combination to give more intense currents than the lead plate of Planté, whilst the latter gives a greater quantity of electricity, a condition favourable to electric lighting by incandescence. The carbon plates have, however, the advantage of not requiring time to form like the peroxidised plates of Planté, and it is interesting to note that Henri pointed out their lack of advantage if the lead plates of Planté could be obtained at first hand in a peroxidised state, a suggestion realised by the plan of M. Faure.

The use of the secondary battery for electric lighting purposes has been patented by Rapieff, Edison, and others in recent years. The one described by Edison in his 1879 patent is identical with that of Professors Houston and

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Thomson. The only claim, therefore, that M. Faure and the society working his patent can set up in England is for the battery itself. This was fully described in the public press of this country and in France before the patent was applied for.

FURTHER CORRESPONDENCE TO "THE TIMES" ON ELECTRIC STORAGE, &c.

TO THE EDITOR OF THE TIMES.

SIR: May I ask space for a few remarks in answer to Sir William Thomson's reply to my letter of the 11th inst.? My purpose in writing that letter was to prevent what seemed to me to be a very probable inference from Sir William Thomson's remarks on Faure's battery; and although Sir William Thomson, in his reply, seems to think that I have done injustice to the battery in the comparison, I cannot think that he really means what he seems to say—that, economically, this battery, weighing 800 times as much as the equivalent of coal, or 80 times as much as the present mechanical equivalent (actually realisable) of coal, would have an advantage, inasmuch as it would have to be carried back empty, making 160 instead of 80 times the carriage of the practical equivalent of coal. One of the great advantages of coal is that it requires no packing-cases or anything which has to be carried back, except the trucks or ships. In the account against the battery I charged nothing for interest, whereas, taking the ordinary rate of goods conveyance on railways—say 20 miles a day, including filling and discharging—the interest of the money equivalent of the weight of lead in the battery would more than cover the equivalent cost of coal if the distance exceeded 10 miles.

As regards the other question, that of the conveyance of power by electric conductors affording a substitute for coal, I confess that Sir William Thomson's second letter seems to me no less calculated to mislead than his first. The entire population of the world cannot go and live within 300 nor yet 1,000 miles of a large waterfall like Niagara, nor can the entire manufactures be carried on in such localities, unless we have some means, such as that furnished by coal, for conveying the raw productions to the spot and the manufactured articles away. In saying that electricity had "been found wanting" I had Sir William Thomson's own estimate in my mind. This seems to be an extreme estimate, and far beyond anything as yet accomplished, and so I presume it was intended to be. Nor do I take the size of the conductor, a half-inch bar of copper, as an indication of the expense. To convey power by water, all that is wanted is, as Pat calls it, "a long hole;" but this hole, the internal diameter of the tube, is no indication of the weight of metal necessary to keep the water in this hole, and it is this which determines the expense. So with electricity; the copper conductor is but the hole—an expensive one, it is true. It is the means of insulation and of getting rid of the heat generated which would cause the greatest expense. But, ignoring these and taking Sir William Thomson's estimate—employ the naked copper, at a cost of about £200 per mile, transmitting, say, 20,000lb., with a loss of 5,000 in 300 miles—let us compare it with coal. To avoid the misleading effect of large numbers, let us take a more familiar unit: 20,000lb. will propel, at eight miles an hour, steamships the carrying capacity of which is 32,000 tons, and the consumption of coal would be 20 tons an hour—say $2\frac{1}{2}$ tons per mile; so that in traversing 3,000 miles 7,500 tons would be burnt, or but little more than 20 per cent. Hence the efficiency of the steamship is ten times as great as the conductor. Or take the case of railway carriage. The coal consumed per ton per mile may be put at ·02lb. for the gross weight of the train and engine, and taking 60 per cent. of this as the load of coals, we have, say, 25,000 tons conveyed 11,000 miles for an expenditure of 5,000 tons. But it may be said that the first cost of railways or ships will be so much greater than that of the conductors. The least estimate for a railway is £5,000 per mile, as against £200 for the copper rod—*i.e.*, 25 times as much; but then 1,000 tons per hour is nothing for a railway, and a ton is 1,000lb. for one hour, actually realisable; so that per lb. per mile, on this moderate estimate, the railway would not cost half as much as the mere copper, while the loss of power, or power expended in transit, would not be one-thirtieth.

I think that these figures will show that I am fully justified in saying that on the most sanguine estimate electricity has been found wanting as a substitute for coal, even for purposes of mechanical power. Of course this is a very general estimate, and there are many things I have been obliged to leave out of account; but I think that none of these will be found to tell in favour of electricity.

And if it be urged that we need not go to Niagara, but that we have power in our own tidal rivers, the obvious answer is that in order to render this power available constructive works would be required of such extent that the interest on the money spent would more than balance the equivalent of coal.

I do not at all mean to imply that electricity may not be the means of rendering water-power available at greater distances than heretofore, but that this must be a small matter as regards the consumption of coal for mechanical purposes. Indeed, all that these developments of our mechanical power have yet done is to enhance the usefulness of coal and to increase the consumption.—Yours, &c.,

Manchester, June 16. OSBORNE REYNOLDS.

[In a further communication published in *The Times* of 22nd inst. Professor Reynolds adds that the capability of the copper conductor should have been stated at 20,000-horse power, and so as to the steamships and the railways; it should have been a ton of coal is 1,000-horse power for one hour.]

TO THE EDITOR OF THE TIMES.

SIR: Would you permit me to say a word or two on a subject of great public interest and of considerable public perplexity—I refer to the so-called "storage of electricity?" The usual condition for the production of a voltaic current is known to be the immersion of two different metals in a liquid called an electrolyte. When two pieces of metal thus immersed are connected with a galvanometer, the existence of a current is declared by the deflection of the needle of that instrument. Substituting for the two metals two clean plates of platinum, and connecting them with the galvanometer, the needle remains unmoved. The platinum plates being homogeneous, there is no reason why a current should start from one of them through the electrolyte rather than from the other. If such currents started they would be equal and opposite, and would, therefore, neutralise each other. In other words, with two homogenous plates of platinum we have no current.

But let the wires connected with these platinum plates be detached from the galvanometer and joined, even for a moment, to a voltaic battery, the current which passes will destroy the homogeneity of the plates. If the electrolyte, for example, be acidulated water, that liquid will be decomposed, a film of hydrogen covering one plate of platinum, and a film of oxygen covering the other. These two films play the part of two different metals in the ordinary voltaic battery; and if the plates of platinum thus coated be connected with the galvanometer, the current produced will be strong enough to dash the needle violently aside.

The experiment may be varied in fifty or five hundred ways, and when, instead of the films of gas, solid layers are deposited electrolytically on one or the other of the homogeneous plates, the duration of the current is prolonged. Several cells thus rendered active, through the agency of an extraneous current, constitute what is known as a "secondary battery."

The discoverer of this battery was a man who, without pecuniary reward, or even the hope of such reward, almost sacrificed his senses to the investigation which resulted in the discovery. The name of this man was Ritter, a native of the small German village of Liegnitz. He died, as Dove remarks, exhausted by restless labour, poverty, and disorderly

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living. I think his name and services ought not to be ignored at the present time.

Other men laboured, and we have entered into their labours. Employing homogeneous plates of lead and rendering them non-homogeneous—converting them, in fact, virtually into different plates—by the action of an extraneous current, M. Planté greatly intensified the effects obtained by Ritter. M. Faure has followed and improved upon M. Planté. Covering the plates of lead with minium, with the aid of the currents now obtainable at a small expense, he has, it appears, produced a secondary battery of great power and of considerable promise from a practical point of view.

But I think scientific men have a right to demur to the phraseology in which M. Faure's extension of the discovery of Ritter has been introduced. It has been severely criticised in the *Révue Scientifique*. Numbers of people in this country have been thrown into perplexity by the first letter on this subject published in *The Times*. With regard, for example, to the "box of electricity," if such language be tolerated, we may call a common packing-case containing a voltaic battery a box of electricity; but I am not sure that science will profit by a terminology which bewilders the public mind.—Your obedient servant, JOHN TYNDALL.

The following appeared in *Nature* of the 16th June:—

I am continuing my experiments on the Faure accumulator with every-day increasing interest. I find M. Regnier's statement, that a Faure accumulator, weighing 75 kilograms (165lbs.) can store and give out again energy to the extent of an hour's work of one-horse power (2,000,000 foot-pounds) amply confirmed. I have not yet succeeded in making the complete measurements necessary to say exactly what proportion of the energy used in the charging is lost in the process of charging and discharging. If the processes are pushed on too fast there is necessarily a great loss of energy, just as there is in driving a small steam-engine so fast that energy is wasted by 'wire-drawing' of the steam through the steam pipes and ports. If the processes are carried on too slowly there is inevitably some loss through local action, the spongy lead becoming oxidised, and the peroxide losing some of its oxygen viciously, that is to say, without doing the proper proportion of electric work in the circuit. I have seen enough, however, to make me feel very confident that in any mode of working the accumulator not uselessly slow, the loss from local action will be very small. I think it most probable that at rates of working which would be perfectly convenient for the ordinary use of fixed accumulators in connection with electric lighting and electric transmission of power for driving machinery, large and small, the loss of energy in charging the accumulator and taking out the charge again for use will be less than 10 per cent. of the whole that is spent in charging the accumulator; but to realise such dynamical economy as this prime cost in lead must not be stinted. I have quite ascertained that accumulators amounting in weight to three-quarters of a ton will suffice to work for six hours from one charge, doing work during the six hours at the uniform rate of one horse-power, and with very high economy. I think it probable that the economy will be so high that as much as 90 per cent. of the energy spent in the charge will be given out in the circuit external to the accumulator. When, as in the proposed application to driving tramcars, economy of weight is very important, much less perfect economy of energy must be looked for. Thus, though an eighth of a ton of accumulators would work very economically for six hours at one-sixth of a horse-power, it would work much less economically for one hour at one horse-power; but not so uneconomically as to be practically fatal to the proposed use. It seems indeed very probable that a tramcar arranged to take in, say 7½cwt. of freshly-charged accumulators, on leaving headquarters for an hour's run, may be driven more economically by the electric energy operating through a dynamo-electric machine than by horses. The question of economy between accumulators carried in the tramcar, as in M. Faure's proposal, and electricity transmitted by an insulated conductor, as in the electric railway at present being tried at Berlin by the Messrs. Siemens, is one that can only be practically settled by experience. In circumstances in which the insulated conductor can be laid Messrs. Siemens' plan will undoubtedly be the most economical, as it will save the carriage of the weight of the accumulators. But there are many cases in which the insulated conductor is impracticable, and in which M. Faure's plan may prove useful. Whether it be the electric railway or the lead-driven tramcar there is one feature of peculiar scientific interest belonging to electro-dynamic propulsion of road carriages. Whatever work is done by gravity on the carriage going down hill will be laid up in store ready to assist afterwards in drawing the carriage up the hill, provided electric accumulators be used, whether at a fixed driving station or in the carriage itself.

University, Glasgow, June 13. WILLIAM THOMSON.

THE CONSERVATION OF ELECTRICITY.

The following letter appeared in *Nature* of June 16:—

In a recent communication to *Nature* (vol. xxiv. p. 78), Professor Silvanus F. Thompson very kindly mentions my latest memoir on "The Conservation of Electricity," and, as I am glad to find, confirms my views on this subject by stating that he has independently arrived at the same conclusions with myself.

As regards, however, the question of priority moved by Professor Thompson, I think I ought to add that an earlier paper of mine, published five years ago, must have escaped Professor Thompson's attention. This was printed as an abstract in the *Comptes Rendus* of the Paris Academy of Sciences for June 19, 1876, under the title, "Extension du Principe de Carnot à la Théorie des Phenomènes Electriques. Equations Différentielles Générales de l'Equilibre et du Mouvement d'un Système Electrique Reversible Quelconque." I there enunciated the law of the conservation of electricity in the same terms as now, and also gave the same analytical method for applying it. I beg leave to quote as a proof the following explicit passage from this abstract:—"L'équation $\int d\,m = o$ a une autre signification plus simple; elle signifie que de l'électricité peux se déplacer, mais ne peut jamais varier en quantité. Ce principe de la conservation de la quantite d'electricité à éte admis par les physiciens dans tous les cas commis jusqu'ici, influence, frottement, &c. . . . . Pour que $\int d\,m = o$ pour tout cycle fermé, il faut que $d\,m$ soit une différentielle parfaite." This method I had already applied in 1875 to the phenomena presented by mercury electrodes (*vide Annales de Chim. Phys.*, 1875). In fact, my latest memoir is merely a renewed attempt to draw, by means of new applications, the attention of physicists to a fact which I cannot help considering as important for the future, viz., that the principle of the conservation of electricity is, *as far as analytical applications are concerned*, the exact analogue to Carnot's principle for heat.

Paris, Faculté des Sciences, June 5. G. LIPPMANN.

ROYAL POLYTECHNIC INSTITUTION.—Mr. Mathew Williams, F.R.A.S., F.C.S., author of "The Fuel of the Sun," "Through Norway with a Knapsack," &c., has been appointed to the management of the above Institution, and commences his duties forthwith.

THE TELEGRAPH CLERKS.—The Birmingham telegraphists intend further to consider the terms of an announcement posted in the office on Tuesday by the local postmaster, pointing out that any advantages of the scheme may be suspended in any office of which the members take part in extra-official agitation. The scheme is denounced as an aggravation instead of an amelioration of the telegraphists' claims.

THE TELEPHONE IN SHEFFIELD.—The Telegraph Office of the General Post Office was this week placed in communication with the Sheffield Telephone Exchange, thus enabling subscribers to the exchange to send their messages direct to or to receive their messages direct from the Telegraph Office. By this means the subscriber is practically placed in electrical communication with all parts of the world from his own office.

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MOLECULAR MAGNETISM.

BY R. C. SHETTLE, M.D.

Having been much interested in reading a paper by Professor D. E. Hughes, F.R.S., on "Molecular Magnetism and the Influence of Elastic Torsion upon a Magnetic or an Electric Conducting Wire," recently read before the Royal Society, and given in your columns, I have considered it will not be unwelcome to your readers to be made acquainted with some researches in which I have been occupied for many years past as to the nature and cause of magnetic phenomena, artificial and terrestrial; the more especially as I believe these investigations will prove that all magnetic force is helicoidal, and therefore that the application of torsion to a wire must, during the operation, render it more or less magnetic.

To avoid occupying more of your valuable space than is necessary, I will at once state the conclusions to which I have been led, after many years' investigation of this branch of study. I will subsequently describe as briefly as possible the means by which I arrived at these conclusions.

Conclusions.

1st. That all the motions of the earth are performed upon the same principle as Hero's steam engine, or of an ordinary resistance machine rotating upon its axis.

2nd. That the earth is a centre which attracts and then distributes force.

3rd. That in consequence of the motion of the earth, through the force which has reached it from the sun, every particle or atom of matter is saturated with kinetic energy; and, further, that this energy, owing to action and reaction, exists either in a state of equilibrium, in which case there is no external manifestation of power, or in a state where balance of power has been destroyed, when polarisation or magnetic phenomena are developed.

4th. That not only magnetic phenomena, but also the correlation of forces in general, are capable of complete explanation by this theory.

5th. That the rise and fall of the barometer, the ascent of the plumule, and the descent of the radicle in vegetable life, result from the operation of the force of the sun, acting upon the earth in strict accordance with the third law of motion.

6th. That the formation of the cells of animal life, together with Brownian movements, are also capable of complete explanation on the same theory.

7th. That the formation of dew, rain, hail, ice, &c., together with the expansion of bodies under cold as well as heat, are the outcome of the action and reaction of the force of the sun as embraced in this theory.

8th. That the various spiral or helicoidal formations which abound in the animal and vegetable kingdoms of nature result from natural manifestations of the earth's energy upon matter free to move whilst undergoing formation, and that cyclonic storms and tornadoes are only local evidences of the same energy in an extended degree.

9th. That the photometer, sonometer, &c., are, together with all forms of electric or magnetic machines, simply due to interferences with the equilibrium of action and reaction, and a corresponding development of molecular forces.

I will now attempt to describe as concisely as possible the grounds upon which I base my theory and conclusions.

The physical characteristics of the blood, and the mode in which it aroused energy in the nerves, formed the basis of my inquiry.

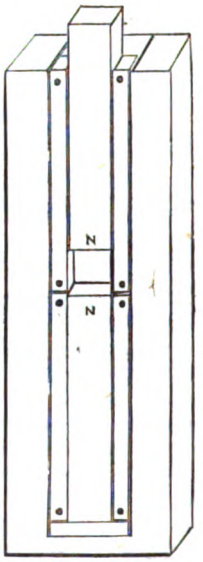
Convinced that a great *physical* law was in operation, I made the magnetic condition of the blood my first study, and after a series of experiments, I demonstrated the fact that arterial and venous blood corpuscles differ in their magnetic conditions; the former being endowed with more active energy than the latter, and, therefore, that more kinetic energy would result from the motion of the arterial than from that of the venous blood corpuscle. The paper on this subject was published in the *Proceedings of the Royal Society*.

With a view of testing the comparative power which each kind of blood, and blood at different temperatures would manifest in the induction of currents of electricity, I wound several layers of very fine silk-covered copper wire upon very thin glass tubes, upon which I wound another coil of similarly covered copper wire larger in size.

When winding these coils, I was much struck by the fact that when applied to the galvanometer they always gave out currents of electricity, which were more or less permanently increased by connecting the coils for a very short time with an active cell. I associated this property with the spiral state of the wires, and deeming the cause to be connected with some great fundamental principle, I determined, if possible, to ascertain its nature before proceeding with the dynamics of the blood.

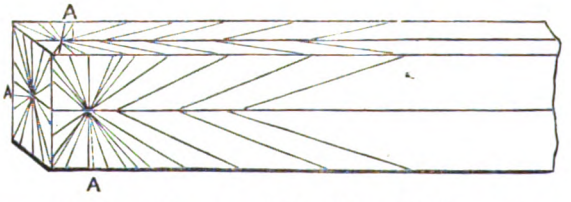
When attentively observing with the above object in view the mode in which iron filings were arranged when shaken upon a convenient support over the poles of a magnet, three points appeared of great importance:—1st, that the curvilinear arrangement is much facilitated by imparting motion to the filings; 2ndly, that sections only of such curves can be thus examined; and 3rdly, the different direction of the curves under the apposition of similar or dissimilar poles.

It now occurred to me that by suspending from a convenient holder by means of a delicate silk fibre a needle point magnet, the silk being attached to the equator, and the magnet *properly* balanced, I should have a particle free to move according to the impetus given it by the magnetic force. I therefore used several of these suspended points varying in length from $\frac{1}{16}$ to $\frac{1}{8}$ of an inch, and by means of these determined the direction of the energy in magnetic bars.



By such means I was able to prove—1st, that the equator of an artificial bar magnet is *always oblique*; 2nd, that the force that emanates from a line about $\frac{1}{12}$ of the length of the magnet, from the pole end in ordinary bar magnets, is ejected mainly from five centres, *i.e.*, one on the centre of each polar surface; 3rd, that lines of force converge from every direction to these centres; 4th, that when a 1in. needle, suspended as above described, is held over either of such centres, it takes on incessant motion, which motion as far as can be ascertained by close observation is of a rotatory character. The account of these experiments is published in the *Proceedings of the Royal Society*, No. 196, 1879.

I next applied myself to determine the cause of the magnetic curves assuming different directions under the influence of similar and dissimilar poles.



(Diagrammative view of the general disposition of the force as it passes up magnetic bars. The true pole really exists at the points A.)

For this purpose I adjusted two bar magnets in a groove, which was made wide enough to receive them side by side, and nearly long enough for them to be placed in it end to end. By means of four strips of wood, each being half the width of a magnet, I was able to fix the magnets in the centre, or on either side of the groove, and to adapt any portion of the pole end of one magnet to any portion of the pole end of the other.

By thus placing the pointed end of a needle ($\frac{1}{8}$ of an inch in length) on the upper edge of the fixed magnet, and then pushing the other towards it, the behaviour of the needle determined the direction of the force acting upon it. By examining the force emanating from every portion of the edges of magnets exposed to the influence of force, emanating from every portion of the pole ends of other magnets, I ascertained the following facts:—1st. That when the two magnets were *exactly* in the centre of the groove, a needle point placed *exactly* on the centre of the edge of the fixed magnet was tilted upwards, and then fell *directly* backward. 2nd. That the inclination to the right or

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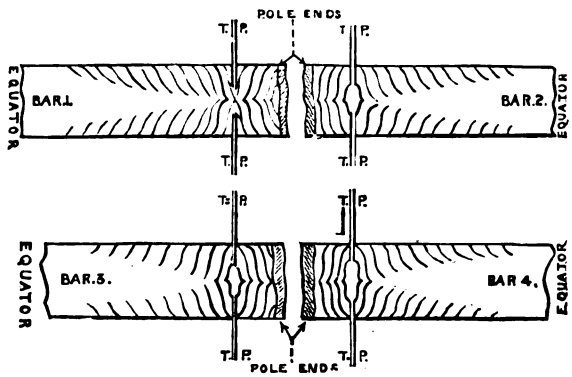
left which the needle points assumed when placed on the edge of the magnet, to the right or left of the axial line, was increased as the movable magnet was pushed up the groove, the free end of the tiny test magnet being at the same time raised by a helicoidal movement until it had acquired a rectangular position to the axis of the bar, when it was thrown backwards, the *larger extremity always pointing diagonally across the fixed magnet to the side of the bar opposite to that upon which it was first placed*, thus showing that the same description of force continued to act upon it when in the act of falling. 3rd. That when the relative position of the two bars was changed, by placing the fixed bar on one or the other side of the groove, still keeping the moving bar in the centre, the same description of phenomena resulted; but the axis of force in the fixed magnet in such case was changed, and situated *midway* between the middle and either edge of the bar. This was proved by the test magnet turning directly upwards, or to the right or left upwards on either side of such line. 4th. That by placing the two magnets as closely together as possible by their similar poles, and the needle-point magnets just on the line of junction, the inclination of the needle magnets was precisely the same as along the line of either magnet, where force is naturally projected from a bar magnet with the greatest energy.

Seeing, then, 1st. That the equator of a magnet is always oblique; 2nd. That the position which needle points assume, when placed over the true pole of a magnet, corresponds with the position of needle points placed over the line of junction of two similar poles; 3rd. That needle points, when placed on the edge of a fixed magnet and subjected to the action of a similar pole of another magnet, move in a helicoidal direction to the right or left upwards, and that the direction of the movements is changed by every alteration in the position of the moving bars; and 4th. That the lines of force which are rendered visible by iron filings, both from similar and dissimilar poles are essentially curved lines, it would appear impossible to deny, 1st. That the waves of energy that emanate from magnets are always of a helicoidal character; 2nd. That the force which passes from the Equator to the Pole proper is met by a similar force from the opposite direction; and 3rd. That the vertical position of the magnetic needle over the true pole is due to force from all directions supporting the needle in such position.



(Bars 1 and 2 show two dissimilar poles in opposition originating attraction. Bars 3 and 4 two similar poles in opposition originating repulsion.)

Theoretically, the curvilinear direction of magnetic force, and the phenomena of magnetic attraction and repulsion, can be completely explained by helices of wire, and I am not aware that such phenomena have hitherto been accounted for in any way. For example, if we take a right or a left hand helix of wire, and then divide such helix across the centre of its length, and move the helices in the direction of the twist, as representative of the line of motion, either pair of helices will move into each other, and mutually attract in proportion of the number of spirals interacting. If we then bend the coils, we have a representation of the curves of magnetic attraction. If we now take one of the right and one of the left hand coils, and place their ends together, again moving them in the direction of the wire, we find that they will mutually repel, and the two ends of the wire will form a triangular space, which is converted into a quadrangular space by two coils similarly placed by the side of the others, thus corresponding with the appearance of the iron filings, indicative of magnetic repulsion.

These experiments of the magnets in the grooves and the coils of wire I exhibited at a *conversazione* of the Royal Society.

Encouraged by the success which had attended my investigations into the cause of the phenomena of artificial magnetism, I determined to ascertain, if possible, the cause of the phenomena of terrestrial magnetism, the more especially as my investigations had already given me the key, as I believed, to the solution of the problem, in the idea that *all magnetic phenomena result from the particular kind of deflection which matter gives to force acting upon it.* This view was strongly supported by the discovery of Sir G. Airy that the pole of a steel magnet is situated about $\frac{1}{12}$ of the length of the bar from the end, while the pole of the galvanic coil is absolutely at, or a little beyond, the end.

Acting upon this view, I set to work to ascertain how the force or energy of the sun could originate such a set of phenomena in the earth.

We know that heat and light are forms of motion, and that wherever heat or light exist, there motion or kinetic energy also exists; consequently, wherever the rays of the sun impinge upon the earth, there waves of energy are also imparted, the direction of which must vary with the relative position of the two bodies. We are also well aware that force is indestructible, and that a line of force as a line of motion must obey the laws of motion, and although it may be, and frequently is, converted into various forms of energy, it always reappears as force. A close scrutiny of the energy of the sun, and the manner in which it is applied to, and then acts upon the surface of the earth, at once appears to me to solve the problem; for we find that, owing to the motion of the sun, and the motion of the earth, energy is constantly being impressed on the earth in such a direction that when taken in connection with the laws of motion, and the spheroidal shape of the earth must give rise to currents of energy round the earth; which currents starting with an inclination to the right or left make their helicoidal circuits round the earth, in proportions diminishing with the earth's circumference, until they are ejected from the north or south magnetic poles as helices of force.

The phenomena more immediately resulting from the action of the sun's energy upon the earth are:—1st. Right and left hand helices of force *which entirely correspond with the results I obtained by my original experiments on artificial magnets, and which are capable of explaining the phenomena of magnetic attraction and repulsion.* 2nd. The motion of the earth in a direction the reverse of that in which force was originally impressed: a feature of great moment in relation to other terrestrial phenomena. 3rd. The orbital and other motions of the earth. 4th. Energy moving incessantly in two opposite directions throughout the earth, in accordance with the 3rd law of motion. Action and reaction being equal and opposite, equilibrium is established by such means, as at the equator of artificial bar-magnets; and after a patient and most searching investigation I have no hesitation in stating that all terrestrial phenomena, from the formation of a particle of dew, or the power which torsion exercises in originating magnetism, according to the researches of Professor Hughes, to the varied phenomena of animal life, are dependent upon the particular manner in which this equilibrium is disturbed by the condition of the matter operating thereupon.

(TO BE CONTINUED.)

ON THE MODERN DEVELOPMENT OF FARADAY'S CONCEPTION OF ELECTRICITY.*

(CONTINUED FROM PAGE 77.)

BY PROFESSOR HELMHOLTZ.

For our own discussion of the electro-chemical phenomena, to which we shall now turn, I beg permission to use the language of the old dualistic theory, which considers positive and negative electricity as two imponderable substances, because we shall have to speak principally on relations of quantity. We shall try to imitate Faraday as well as we can by keeping carefully within the domain of phenomena, and therefore need not speculate about the real nature of that which we call a quantity of positive or negative electricity. Calling them substances of opposite sign, we imply with this name nothing else than the fact that a positive quantity never appears or vanishes without an equal negative quantity appearing or vanishing at the same time in the immediate neighbourhood. In this respect they behave really as if they were two substances which cannot be either generated or destroyed, but which can be neutralised and become imperceptible by their union. I see very well that this assumption of two imponderable fluids of opposite qualities is a rather complicated and artificial machinery, and that the mathematical language of Clerk Maxwell's theory expresses the laws of the phenomena very simply and very truly with a much smaller amount of hypothetical implications; but I confess I should really be at a loss to explain without the use of mathematical formulæ what he considers as a quantity of electricity, and why such a quantity is constant, like that of a substance. The original old notion of substance is not at all identical with that of matter. It signifies, indeed, that which behind the changing phenomena lasts as invariable, which can be neither generated

* From the *Chemical Society's Journal.*

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nor destroyed, and in this oldest sense of the word we may really call the two electricities substances. I prefer the dualistic theory because it expresses clearly the perfect symmetry between the positive and negative side of electric phenomena; and I keep the well-known supposition that as much negative electricity enters where positive goes away, because we are not acquainted with any phenomena which could be interpreted as corresponding with an increase or a diminution of the total electricity contained in any body. The unitary theory, which assumes the existence of only one imponderable electrical substance, and ascribes the effects of opposite kind to ponderable matter itself, affords a far less convenient basis for an electro-chemical force. Already, before Faraday went to work, an elaborate electro-chemical theory had been established by the renowned Swedish chemist, Berzelius, which formed the connecting link of the great work of his life, the systematisation of the chemical knowledge of his time. The starting point was the series in which Volta had arranged the metals according to the electric tension which they exhibit after contact with each other. Metals easily oxidised occupied the positive end of this series, those with small affinity for oxygen the negative end. Metals widely distant in the series develop stronger electric charges than those near to each other. A strong positive charge of one metal, and a strong negative of the other, must cause them to attract each other and to cling to each other. The same faculty of exciting each other electrically was ascribed by Berzelius to all the other elements. He arranged them all into a series, at the positive end of which he placed potassium, sodium, barium, calcium, &c.; at the negative end oxygen, chlorine, bromine, &c. Two atoms of different elements coming into contact are supposed to excite each other electrically, like the metals in Volta's experiment. Berzelius's conceptions about the distribution of opposite electricities in the molecules, and his deductions regarding the intensity of these forces, were not very clear, and not in harmony with the laws of electric forces which had already been developed by Green and Gauss. A fundamental point which Faraday's experiment contradicted was the supposition that the quantity of electricity collected in each atom was dependent on their mutual electro-chemical differences, which Berzelius considered as the cause of their apparently greater chemical affinity. His theory of the binary character of all chemical compounds was also connected with this electro-chemical theory. Two elements, as he supposed, one positive the other negative, could unite to a compound of the first degree a basic oxide or an acid's; two such compounds into a compound of the second degree, a salt. But there was nothing to prevent one atom of every positive element from uniting as directly with two, three, or even seven of another negative element as with one. The same was assumed by Berzelius for negative elements. The modern experience of chemistry directly contradicts these statements. But although the fundamental conceptions of Berzelius's theory have been forsaken, chemists have not ceased to speak of positive and negative constituents of a compound body. Nobody can overlook that such a contrast of qualities as was expressed in Berzelius's theory really exists, well developed at the extremities, less evident in the middle terms of the series, and playing an important part in all chemical actions, although often subordinated to other influences. When Faraday began to study the phenomena of decomposition by the galvanic current, which of course were considered by Berzelius as amongst the firmest supports of his theory, he put a very simple question, the first question, indeed, which every chemist speculating about electrolysis ought to have thought of. He asked, what is the quantity of electrolytic decomposition if the same quantity of electricity is sent through several electrolytic cells? By this investigation he discovered that most important law, generally known under his name, but called by him the law of definite electrolytic action. When he began his experiments, neither Daniell's nor Grove's battery was known, and there were no means of producing currents of constant intensity. The methods of measuring this intensity were also in their infancy. This may excuse his predecessors. Faraday overcame this difficulty by sending the same current of electricity for the same time through a series of two or more electrolytic cells. He proved at first that the dimensions of the cell, and the size of the metallic plates through which the current entered and left the cell, had no visible influence upon the quantity of the products of decomposition. Cells containing the same electrolytic fluid between plates of the same metals gave always the same quantity, after being traversed by the same current. Then he compared the amount of decomposition in cells containing different electrolytes, and he found it exactly proportional to the chemical equivalents of the elements, which were either separated or converted into new compounds. Faraday concluded from his experiments that a definite quantity of electricity cannot pass a voltametric cell containing acidulated water, between electrodes of platinum, without setting free at the negative electrode a corresponding definite amount of hydrogen, and at the positive electrode the equivalent quantity of oxygen, one atom of oxygen for every pair of atoms of hydrogen. If, instead of hydrogen, any other element capable of replacing hydrogen is separated from the electrolyte, this is done also in a quantity exactly equivalent to the quantity of hydrogen which would have been evolved by the same electric current. According to the modern chemical theory of quantivalence, therefore, the same quantity of electricity passing through an electrolyte either sets free or transfers to other combinations always the same number of units of affinity at both electrodes. The simple or compound halogens separating at the other electrodes are equivalent, of course, to the quantity of the metallic element with which they were formerly combined. According to Berzelius's theoretical views, the quantity of electricity collected at the point of union of two atoms ought to increase with the strength of their affinity. Faraday demonstrated by experiment that so far as this electricity came forth in electrolytic decomposition its quantity did not at all depend on the degree of affinity. This was really a fatal blow to Berzelius's theory.

Since that time our experimental methods and our knowledge of the laws of electrical phenomena have made enormous progress, and a great many obstacles have now been removed which entangled every one of Faraday's steps, and obliged him to fight with the confused ideas and ill-applied theoretical conceptions of some of his contemporaries. The original voltameter of Faraday, an instrument which measured the quantity of gases evolved by the decomposition of water, in order to determine with it the intensity of the galvanic current, has been replaced by the silver voltameter of Poggendorff, which permits of much more exact determinations by the quantity of silver deposited from a solution of silver nitrate on a strip of platinum. We have galvanometers which not only indicate that there is a galvanic current but likewise measure its electro-magnetic intensity very exactly, and in a very short time, and do this as well for the highest as for the lowest degrees of intensity. We have electrometers, like the quadrant electrometer of Sir W. Thomson, able to measure differences of electric potential corresponding to less than one hundredth of a Daniell's cell. As for the frequently-used term of electric potential, a term introduced by Green, you may translate it as signifying the electric pressure to which the positive unit of electricity is subject at a certain place. We need not hesitate to say that the more experimental methods were refined the more completely were the exactness and generality of Faraday's law confirmed.

(TO BE CONTINUED.)

TELEGRAPH SHARE LIST.

Companies.	Closing Prices June 22.		Business Done Week Ending June 22. Highest.		Lowest.	
Anglo-American	53,	54	55¼		53¼	
Do. Preferred	85,	86	86½		85½	
Do. Deferred	25,	26	27¼		25½	
Brazil Submarine	10⅞,	11	11		10⅞	
Cuba	9⅛,	¼	9⅜		9⅛	
Do. Preference	16⅜,	17½	—		—	
Direct Spanish	4½,	5	4 13-16		4½	
Do. Preference	13½,	14½	14½		14	
Direct United States Cable	10⅞,	11	11		10⅞	
Eastern Telegraph	10½,	⅜	10⅜		10½	
Do. 6 per Cent. Preference	12⅞,	13½	13		13	
Do. 5 per Cent. Debentures, 1899	107,	110	—		—	
Eastern Extension	11,	¼	11¼		11¼	
German Union	11½,	12	11		—	
Globe Telegraph and Trust Company	6⅛,	⅛	6¼		6⅛	
Do. Preference	12½,	⅜	12⅝		12½	
Great Northern	13½,	¼	13⅝		13⅜	
Indo-European	28,	29	—		—	
Mediterranean Extension	2⅛,	⅜	2⅛		2⅛	
Do. Preference	9½,	10	—		—	
Reuter's	11,	12	—		—	
Submarine	280,	290	—		—	
West India and Panama	2⅛,	⅜	2⅛		2 3-16	
Do. 1st Preference	7⅞,	8⅛	8		7⅞	
Western Brazilian	8⅛,	¼	8⅜		8⅛	
West. Union 7 per Cent. 1st Mortgage	123,	128	127½		126½	
Do. 6 per Cent. Sterling Bonds	106,	110	109½		109½	

TRAFFIC RECEIPTS FOR MAY, 1881.

Companies.	May, 1881.	May, 1880.	Increase.	Decrease
Anglo-American Telegraph Company	£49,880	41,970	7,910	—
Cuba Submarine Company	3,000	2,972	28	—
Direct Spanish Telegraph Company	1,547	1,334	213	—
Direct United States Telegraph Company	16,630	13,990	2,640	—
Eastern Telegraph Company	43,872	42,963	909	—
Eastern Extension Telegraph Company	29,523	26,570	2,953	—
Great Northern Telegraph Company	21,600	—	—	—

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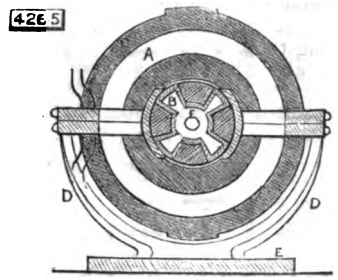
RECENT INVENTIONS.

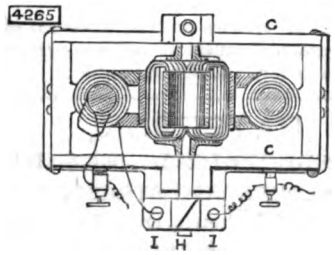
ABSTRACTS OF SPECIFICATIONS.

4265. IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES. *W. R. Lake.—Dated 19th October*, 1880.—(*A communication from C. A. Hussey and A. S. Dodd.*) 6*d*.

Fig. 1 is a side view, partly in section, of the machine. A is the magnet having inward projections with arc-shaped extensions at their inner end as shown; the magnet is supported by stan-



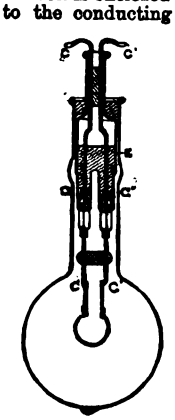
dards D on base piece E. F is an armature having radial projections B, the wire being wound in intervening spaces C as shown; it has an opening from end to end through centre, and also openings from end to end through the radial projections, all of which are in communication; it is provided with journals which are attached to skeleton frames or end plates by screws or other



wise (see Fig. 2). These journals are supported in bearings G, H is the commutator with brushes I. For this invention it is claimed that there is produced an effective machine by rotation of the armature before the poles of the magnet, and before the whole length of the magnet, and the wire surrounding it all at the same time, and thus throughout the entire field of force.

4393. IMPROVEMENTS IN ELECTRIC LIGHTING APPARATUS, *W. R. Lake.—Dated 27th October*, 1880.—(*A communication from H. S. Maxim.*) 6*d*.

The object of this invention is so to construct the globe used in incandescent lighting, that it may be readily taken apart for the insertion of new carbons, and that the joints may be perfectly air tight. The carbon is enclosed in a glass globe, and clamped to the conducting wires C C¹, the



neck of the globe being wide enough to permit free passage for carbon and connections. E is a hollow ground glass stopper, air tight with globe neck. G G¹ are tubular extensions of E, sealed directly to the conducting wires. When the carbon is of low resistance each conducting wire is divided into a number of branches, where it passes through the glass as shown in figure.

4428. IMPROVEMENTS IN ELECTRIC LAMPS, *J. H. Johnson.—Dated 29th October*, 1880.—(*A communication from A. Berjot.*)—(*Not proceeded with.*) 4*d*.

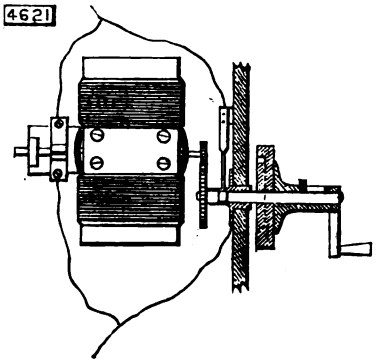
The inventor employs a regulating apparatus arranged in the form of a parallelogram with flexible joints in combination with a number of pairs of carbons which are consumed in succession, the current being automatically diverted into a fresh pair when the pair in use are consumed. The inventor further provides against the loss of weight consequent on the consumption of the carbons automatically, there is also an arrangement for shutting off the current when the last pair of carbons has been consumed, and an electro solenoid or device for regulating the length of the arc when several apparatus are working on one circuit.

4491. PREVENTION OF EXPLOSIONS IN COAL MINES, *T. Canning and W. E. Thomas.—Dated 3rd November*, 1880. 8*d*.

Above the pithead framing is fixed a roof, the covering of which is a conductor of electricity, such as a wrought iron roof, insulated or not, and fitted with a lightning rod and conductor. The wire ropes or rods, or any metallic communication with the mine, are caused to pass through a metallic sleeve formed with a number of internal points, which, if electricity of high tension be on the rope or rod, draw it off, a series of sparks passing.

4621. IMPROVEMENTS IN MAGNETO-ELECTRIC SIGNAL APPARATUS, *E. G. Brewer.—Dated 10th November*, 1880.—(*A communication from E. H. Johnson and G. A. Edison.*) 6*d*.

The object of the invention is to enable magneto electric machines to be cut out of circuit when not in use, and also to enable two distinct signals to be given, as for instance a continuous ring and an intermittent ring. To accomplish the first of these objects a shunt circuit is formed round the magneto machine, a portion of which circuit is a contact spring taking against a contact point. The actuating handle is attached to a sleeve which is loose upon the main driving shaft, but secured thereto by a pin on the shaft. On the inner end of the sleeve is a disc which takes against a rod, whose other end beats against



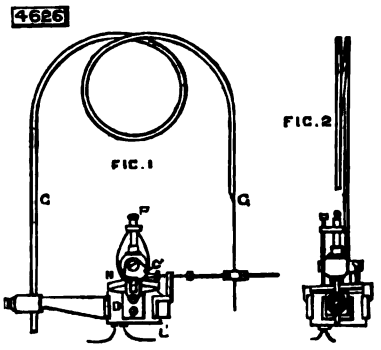
the contract spring, the force of which is used to normally hold the rod pushed against the disc, so that the sleeve is as far out on the shaft as the slot and pin permit, in which condition the spring impinges on the contact point, closing the shunt circuit, thus practically cutting the generator out of circuit. Upon rotation the sleeve turns loosely on the shaft till the outer end of the slot reaches the pin, when sleeve and shaft turn together; the slot being trianglar causes the carrying inward of the sleeve and disc pushing the rod against the contact lever, causing it to leave the contact point, breaking thereby the shunt circuit, and compelling the current from the generator to traverse the main circuit. Upon cessation of use the parts return to their normal position. To effect two distinct signals, a modification of the above apparatus is used.

4628. IMPROVEMENTS IN STEP-BY-STEP TYPE PRINTING TELEGRAPHS, *G. F. H. W. Higgins.—Dated 16th November*, 1880. 6*d*.

The printing is by this apparatus in parallel lines instead of in a continuous line. A step-by-step escapement rotates the type wheel, to which is geared the type axle, pivotted in and carried by a frame acting as a lever, the short end of which carries the armature of an electro-magnet. An auxiliary electro-magnet ensures the sychronism of the sending and receiving instruments.

4626. IMPROVEMENTS IN APPARATUS FOR LIGHTING AND EXTINGUISHING GAS BY MEANS OF ELECTRICITY, *W. R. Lake.—Dated 10th November*, 1880.—(*A communication from G. D. Bancroft.*) 6*d*.

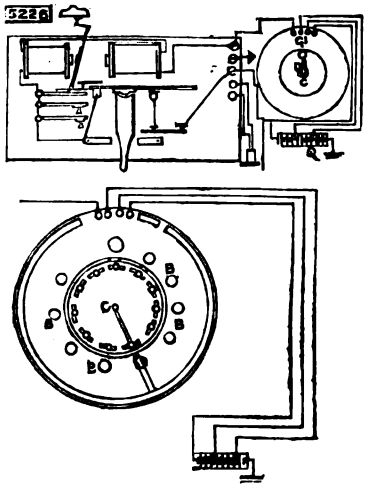
Fig. 1 is a front view of a gas-burner and the apparatus for lighting it, and Fig. 2 is a side elevation of same. To light the gas the operator sends a current over the line wire L¹. The electro-magnet contained in the box D overcoming the force of a spring working in the U-shaped arms pulls down the armature H, and releases the shoulder C¹ from a projection. The spring G being at the temperature of the atmosphere forces



inward the segmental arm, thereby opening the cock at the same time. The current passing through the platinum wire P so heats the same as to ignite the gas; when the operator then breaks his circuit at his distant station the projection flies up against the shoulder C¹. After the gas has burned a few minutes the thermo-spring G will become so heated as to exert its force in the opposite direction, and a single impulse of the electric current then sent over the line will release the shoulder C¹ and close the cock.

5226. TRANSMITTING TELEPHONIC MESSAGES, &c., *A. M. Frankenburg.—Dated 14th December*, 1880. 8*d*.

The apparatus described in this patent is intended to admit of district and other telephones being controlled in their functions, use, and adjustments, by means of a battery and transmitter at the central station. The operating devices of the transmitter are mounted on a suitable carrier, and consist of a series of push buttons equal to the number of stations, and circularly arranged on a support with stems passing through support



and pressing in springs underneath. There is a double set of springs, one set in contact with an outer segment the other with an inner. The outer segment is connected with whole battery, the other with part of battery only. A vertical shaft, C, carries arm D, by which means contact is made and broken. The circuit to main office is made through line wire to transmitter post F, then to arm D, and to binding post G¹ and on to Q. The figure will assist in showing arrangement.

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By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

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31st March, 1880.

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M. Trouve's Boat.—M. Trouvé is continuing his experiments with his electrically-propelled boat.

Brazilian Submarine Telegraph Company.—The traffic receipts of this company for the week ended the 24th June amounted to £2,777.

West India and Panama Telegraph Company.—The Legislature of Jamaica have decided not to increase the subsidy at present made to this company.

Messages to Turkey.—The public are again warned by the Post Office that telegrams in code or cypher are not accepted for transmission to Turkey or Bulgaria.

University College.—At the *conversazione* which took place at this college in the beginning of this week, several of the Crompton arc lights were used to illuminate the quadrangle.

Greece.—A telegram from Athens dated Sunday last says:—The Turks have destroyed the telegraphic communication between Arta and the Greek frontier, carrying away the posts and all the materials.

Dividend.—The Eastern Extension Telegraph Company (Limited) have declared an interim dividend for the quarter ended March 31 last of 2s. 6d. per share, or at the rate of 5 per cent. per annum free of income-tax.

Eastern and South African Telegraph Company.—The coupons on the 5 per cent. mortgage debentures of this company, due on the 1st July, will be paid on and after that date by Messrs. Barclay, Bevan, and Co.

"A Family of Inventors."—Under this title the current number of *Cassell's Magazine* has an article on the Brothers Siemens, with portrait illustrations of the three brothers, Frederick, William, and Werner Siemens.

Universal System of Units.—M. Lippmann thinks that the adoption of a universal system of units would be facilitated by taking as the fundamental units of time, distance, and force, the second, the meter, and the gram.

Tunis.—Telegrams from Tunis of Saturday and Sunday last say that telegraphic communication with Gabes and Sfax is interrupted. With reference to the first-named place, the telegraph poles had been burnt by the insurgent tribes.

Demise of a Telegraph Paper.—The *Boston Telegram*, which we announced a week or so back as having been started in the city of that name in the United States, has come to an untimely end, having issued but two numbers.

Western and Brazilian Telegraph Company.—The traffic receipts of this company for the week ended the 24th June amounted to £1,877, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Company.

Electric Light in Moscow.—*La Lumière Electrique* says that the City of Moscow has acquired 32 electric lamps from the Russian Electrotechnical Society, on the Tchikoleff system, with which it is intended to illuminate the Place du Dôme de Saint-Sauveux.

The New American Cable.—The telegraph steamer "Faraday" picked up on Tuesday the buoyed end of the new American cable off Land's End, and at seven a.m. proceeded laying the mid-ocean section of the cable to join the buoyed end off Newfoundland.

Electric Light in Edinburgh.—The North British Railway Company are about to follow the initiative of the Town Council of this city, and will illuminate the Waverley Station on their line by the electric light in August next, on the occasion of the Queen's visit.

Improved Telephonic Communication.—The United Telephone Company have established offices in Lonsdale-chambers, Chancery-lane, and at the Metropolitan Railway Station at Westminster Bridge, so that direct communication is now available between the law courts and Westminster.

Another New Cable.—It is announced that a contract has been signed on behalf of the International Ocean Telegraph Company and the Mexican Government for a new cable between the United States and the West Indies, Mexico, and Central America, by way of Cuba and Yucatan, the work to begin immediately.

New Telegraph Company.—The International Telegraph Company filed articles of association at Albany, New York, on the 4th of June. The capital is fixed at ten million dollars. The company is said to intend commencing the erection of its lines at Washington, and extend them southwards *viâ* Richmond and Savannah to Mobile, during the summer.

Erratic Carbons.—At the Leicester-square Panorama the other day one of the electric lamps which illuminate the picture of Balaclava shot its live carbon on to the straw which fills the ambulance waggon lying on the foreground between the picture and the platform. The whole blazed in an instant, and serious consequences were only averted with difficulty.

Prices.—The prices as quoted this week are:—For guttapercha, genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d.; india rubber, fine Para, 3s. 6½d. to 3s. 6¾d.; negrohead, 2s. 3½d.; central American, 1s. 11d. to 2s. 5d.; Assam and Pegu, 1s. 3d. to 2s. 1d.; other East Indian, 1s. 9d. to 2s. 4d.; Madagascar and Mozambique, 1s. 6d. to 2s. 4d. The market remains inactive.

The Consolidation and the U.S. Oil Trade.—In his address at the annual meeting of the Petroleum Exchange President George H. Lincoln is reported to have said that the telegraph consolidation had impaired the telegraphic facilities of the oil trade. He suggested that the oil interest should build a telegraph line for the use of the trade between New York and the oil regions.

The Aggrieved Telegraphists.—Various meetings are reported to have been held in the provinces during the past week at which great dissatisfaction was expressed with the new scheme of payment, and much indignation at the language of the Treasury letter. It is noticeable, however, that the meetings in London have subsided. This looks as if the metropolitan clerks were satisfied.

Telegraphs in China.—The first shipments of the materials required for the first section of the telegraph land lines in China, to be erected by the Great Northern Telegraph Company for the Chinese Government, have arrived, and the line is being pushed forward. The authorities have decided to have a duplicate in place of a single line, and the extra materials required have been sent for.

Weston *v.* Brush Companies.—A suit has been commenced in the United States Circuit Court at New York by the Weston Electric Light Company for infringement of one of the Weston patents on electric lamps. The patent was recently issued to Mr. Weston after a long contest in the Patent Office with Mr. Brush, and is said to cover very important features of the Brush system.

Accident by Lightning.—The *Daily News* correspondent, telegraphing from Geneva on Monday last, reported that

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Iserable, a village in the Valais, with about 300 houses, had been set on fire by lightning and utterly destroyed. Further information says that a flash also struck a squad of recruits who were being drilled at Colombiers, Neuchatel, killing one and wounding or paralysing six others.

Recording Thunderstorms.—The thunderstorms of the future will be recorded in detail at the telegraph offices in France. M. Cochery, the Minister of Posts and Telegraphs, has, at the suggestion of M. Mascart, of the Meteorological Office, had a number of forms printed and circulated amongst the various offices, with instructions for recording observations of every thunderstorm that takes place.

Another Electric Light Company.—The Dublin Electric Light Company is announced, with a capital of £150,000, in 15,000 shares of £10 each. Amongst the directors are the Lord Mayor of Dublin, E. Dwyer Gray, Esq., M.P.; and T. J. Montgomery, who is also a director of the Brush Company. It has been formed, as its name would imply, to introduce the electric light into Dublin "for public and domestic use." The company is to work the Brush patents.

Destruction of Telegraph Instruments by Lightning.—During a thunderstorm this month the instruments at the D. and H. C. Co.'s office, White Mills, were completely demolished by lightning, although the pins were all in and the switch-board is furnished with lightning arresters. This simply proves that the wire from the switch-board to the ground was insufficient to carry off the electricity coming in on the wires, a fault often found in telegraph offices.—*Operator.*

Local Authorities and Overhead Wires.—The answer given by Mr. Gladstone to a question in the House of Commons the other day, as to the liability of local authorities in cases of accidents caused by overhead wires, seems to have put local boards, vestries, &c., on the *qui vive*. At the last meeting of the St. Saviour's Vestry the subject was discussed with particular reference to the wires that are being put up in all directions by the telephone companies. It was agreed to send a letter to the Board of Trade on the subject.

Parliament and the Telegraphists.—The answer which Lord F. Cavendish, the Financial Secretary to the Treasury, gave to Mr. O'Donnell on Monday evening has conveyed a general impression that the promoters of the agitation will be punished by being denied the benefits of the new scheme, or, at all events, such of the men as continue the agitation. According to the *Chronicle* Mr. Macliver has succeeded in obtaining some amendation of the scales, and, it is said, that the Treasury will issue a revised scheme in a day or two.

Telegraph Poles.—We hear that Mr. Pugh, M.P. intends on Monday next to ask the Postmaster-General whether it is a fact that the Post Office Department uses foreign timber only for telegraph posts, whereas many railway companies use home-grown timber for that purpose; and, if so, whether he will cause inquiry to be made as to the relative price and value of the home-grown and foreign timber in different portions of the United Kingdom, with a view to directing the use of home-grown timber where such a course can be adopted with advantage or without prejudice to the public service.

Music by Telephone.—Successful experiments were lately made in Paris with Ader telephones, which were connected by means of wires to the Academy of Music. The *Tribut de Zamora* was being performed at the time of the experiments, and was reproduced by the telephones with marvellous distinctness. M. George Berger, Commissioner-General of the Electrical Exhibition, was amongst those present at the experiments, one of the results of which will be that 150 telephones are to be established at the Exhibition for the use of the public, so that they may enjoy this far away music.

The Electrical Exhibition.—A small pond, about 16 metres in diameter, and 70 centimetres deep, will be constructed near the Exhibition buildings, in the centre of which a miniature lighthouse, furnished with the electric light, will be placed. M. Trouvé will also exhibit his boat on this pond. Amongst the curiosities that will be shown will be a picture of the 16th century, said to have come from Holland originally, representing an old man holding a peculiarly shaped instrument in his hand. In the corner of the picture is inscribed a latin sentence, which is construed thus:—"By means of salts, I will produce light."

Electric Light for Southwark.—At the last meeting of the St. Saviour's Vestry a letter was read from the Société Générale d'Electricité with reference to the lighting by electricity of a portion of Blackfriars-road, Southwark Bridge-road, Southwark-street, and High-street, Borough, stating that seventy to eighty lamps would be required to light the locality named, and the cost would be 1½d. per light per hour, the contract to be for ten years. Messrs. Siemens Brothers wrote offering to light fifty-five lamps, the Board to make the necessary trenches, for £2,400 a year. The Brush Company and the Electric Light and Power Generator Company were not in a position to send in tenders. The question was deferred to a subsequent meeting.

Electrical Phenomena.—An American contemporary remarks that exceptional electrical phenomena are added to the earthquakes, floods, storms, and comets that have already made this a year of marvels. About a week ago some of the people of Brooklyn were startled by an enormous fireball that is said to have exploded in the air over the city with a deafening report. On Sunday a similar fireball burst with a great noise close by the new statue of General Kearney in Newark. Strange forms of lightning have been seen in England of late. Many scientific men trace a close connection between the excited condition of the sun and electrical displays on the earth. As the sun has not yet reached the culmination of its period of disturbance, yet more startling outbursts of nature's forces in our atmosphere are likely to be witnessed during the ensuing summer.

Underground Wires in America.—The Mutual Union Telegraph Company, as they cannot obtain permission to erect overhead wires in Washington, are trying the experiment of laying them in the sewers. The wires, which are needed for the city service and for connection with lines outside the city, are twisted cable form, and covered with a non-conductor and waterproof coating. Outside the city limits these wires emerge from the sewers and join those on the poles. The cable made of the twisted wires is attached firmly to the arched roof of the sewer, and thus raised above all interference from water, except in case of floods. The cables are laid by men enveloped in rubber clothing and provided with safety lanterns, provision being made for conducting fresh air to the workmen by means of india rubber tubes attached to their suits.

Legal.—The American Bell Telephone Company, of Boston, has brought a suit in the United States Court in Brooklyn against the Metropolitan Telephone Company, the Brooklyn Central Telegraph Company, and seventeen defendants, who live in Brooklyn, for an alleged infringement upon its patent. The complaint sets forth that Alexander G.

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Bell, of Massachusetts, was granted letters patent on March 7, 1876, for a new and useful improvement in telegraphy. These were assigned on the 22nd of June, 1880. There are now 100,000 electric speaking telephones in use, and but for the alleged wrongful acts of the defendants it is alleged the plaintiff would have enjoyed the sale and exclusive right to use this invention. The defendants, the complaint avers, have jointly made, sold, and used telephones embracing inventions secured to the plaintiff.

Telegraph Extensions in British Columbia.—Several important extensions of telegraphic communication have been made during the past winter in British Columbia under the direction of Mr. F. N. Gisborne, Superintendent of Government Telegraph Lines. A cable of two miles across Saanich Arm, another of one mile between Gabriola Island and Vancouver, one of twenty miles between Valdes Island and Point Gray on the mainland, and two of half a mile each across the Fraser River have been laid. The cables between Sydney Island and San Juan Island, San Juan and Lopez Island, and Lopez and Fidalgo Island have also been repaired, and the land lines throughout the Province have been repaired. Such work, successfully performed during an unusually severe winter, shows the energy with which the Canadian Government and its officials are carrying on important works for opening up the interior of the Dominion. —*Colonies and India.*

Telegraphists and Sorting Clerks.—An old telegraphist directs our attention to, amongst other things, the significant way in which the correspondence between Mr. Fawcett and the Treasury emphasises the designation "telegraphists." He points out that this is a pure invention of the Post Office. The companies called their young men "telegraph clerks," and their supervising officers "clerks in charge." The Post Office has all along been striving to obliterate this designation since the transfer, and now it is officially superseded. Our correspondent even suspects that the class with which the telegraphists are henceforward to be linked has been raised for the purpose of depressing the telegraph clerk. Sorters have hitherto been called sorters, but in the correspondence referred to they are uniformly styled "sorting clerks." If this is true, and our correspondent's inference be correct, the contrast is very invidious, and unless there is some sinister motive at the bottom of it, it seems to us altogether illogical.

Electric Light in the House of Commons.—Further experiments were made in the House towards the end of last week with the electric light under new conditions, the carbons being enclosed in stained instead of opaque glass, by which means a softer and more agreeable light was obtained. The experiments were continued on Monday of this week, when the House was lit partly by gas and partly by the electric light. The only gas lights actually within the House are those under the galleries, the general illumination being obtained from gas lights above the transparent roof. These do not appear to have been excelled by the electric light tried last week; but the replacing of the lights under the galleries by Swan lamps has given great satisfaction, both as regards the light itself and the improved purity of the atmosphere. Twelve Brush arc lamps replaced seventy-two gas ring burners in the body of the House, and thirty-two Swan lamps took the place of the gas jets under the gallery. On Tuesday Mr. Lefevre said, in answer to a question, that he gathered from the experience of hon. members that they were not satisfied with the experiments. He must say those experiments had been made under considerable difficulties, and further experiments could not be made without removing the gas lamps. Under these circumstances he should postpone the matter until the recess.

The Press and the Telegraph Clerks.—One of the difficulties in the way of forming a correct opinion upon the dispute between the telegraphists and their employers is the very one-sided line taken respectively by the daily and the weekly papers. The unanimity on the part of the former is, strange to say, independent of political bias; so that we cannot avoid the inference that the general unanimity of the weeklies in the other direction is explained only by their comparative independence of the aggrieved operators. We have thus no trustworthy evidence from any quarter, and nothing is so plain as that the writers generally know very little about what they are discussing. This was conspicuous in the gushing advocacy of the dailies, and it is now equally manifest in the cold blooded cynicism of the high class journals. One of these latter, for example, condemns the agitators on the ground that they are not compelled to sell their services for less than they are worth, as they are free to go about their business. This is not quite true of any civil servants of long standing, and it is the very reverse of true as regards the post office telegraphists, whose masters possess the monopoly of telegraphic employment in this country. It is this circumstance, indeed, which entitles the telegraph operator to merciful and even generous consideration at the hands of the public service.

Indian Telegraph Department.—Of all public departments (says the Calcutta *Englishman*) one would have supposed that the telegraph, trained as it must be to promptitude in its doings, would be the least likely to lay itself open to criticism by delay in the preparation of its administration reports. We see, however, that the report for the year 1879-80 was not submitted till the 1st December last, and has only just been published. The public can hardly be expected to take a very lively interest in the facts after so long an interval. It is not many years since the telegraph department was worked at a loss to the revenue. In the year under notice it made a net profit of 13,19,363 rs. as compared with 6,08,246 rs. in 1878-79. The number of paid telegrams had increased from 1,371,721 to 1,562,371, and the gross receipts from 35,97,015 rs., to 42,51,446 rs., while the net revenue expenditure had been reduced from 29,70,607 rs. to 29,09,992 rs. Of the improvement, amounting to 6,95,156 rs. in the revenue from messages, 4,48,123 rs. was, however, due to an increase in the number of State telegrams connected with the military operations on the frontier. The increase in the receipts on account of private telegrams was 2,41,021 rs. It is noteworthy that while the revenue from private foreign messages has increased steadily from 5,03,915 rs. in 1872-3, when the present tariff was introduced, to 9,79,809 rs. in the year under review, that from private inland messages reached a maximum in 1877-78, when it was 15,85,891 rs., as compared with 9,96,150 rs. in 1872-73. The following year there was a sudden fall of a lac and a half of rupees, which was only partially recovered last year, when the receipts were 15,32,853 rs. The value of the Press messages sent during the year was 51,497 rs. Notwithstanding the increased traffic the speed of transmission on the main lines was practically maintained.

Hailing Electricity.—A correspondent of the *Operator* writes under date Yreka, California, as follows:—"We had connecting the office with a house an acoustic telephone, put up in the usual manner, by being insulated at each end, the small wire running direct to the diaphragm, and suspended at the supports by the usual twine loop. One afternoon, during a very hard hail storm, the hailstones

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falling very rapidly and of considerable size, I was attracted to the telephone by a loud sound, and thinking some one at the house was calling, I stepped over to the instrument to answer. I had a large meerschaum pipe in my hand at the time, holding it by the bowl, and as I was about to answer, I brought the amber mouthpiece of the pipe nearly in contact with the small wire. Instantly a discharge took place. A steady stream, or a regular voltaic arc, formed, igniting the amber, but I felt no shock. I drew my hand away, finding the amber partly burned. I then tried a piece of clip paper, holding it near the wire, when instantly it took fire with a report similar to the discharge of a Leyden jar. I felt considerable shock this time. Thinking that the wire had become crossed with the San Francisco and Portland wires, I examined it, but found it all right, and that in no way could it have short circuited the large main batteries in the battery room. Still, to verify it further, I found that a telephone across the street was similarly affected. Now as to the cause of this singular disturbance. It did not seem to be atmospheric, as no indication of that condition was manifested on the Morse instruments. Was it frictional, produced by the rapidly-falling hailstones on the wire? Or was it the discharging of each hailstone, charged with a high positive potential from the upper atmosphere, as it came in contact with the wire? The wire being of some length, and insulated at supports by dry twine, and as no rain fell with the hail, may have acted as a condenser which, by the rapidly-falling hailstones discharging themselves kept itself charged, and on bringing my hand near the wire discharged itself, thus establishing an equilibrium of the opposite tensions. Its very high potential showed it to be static electricity. This natural condenser lasted as long as it hailed but no longer."

The Telegraph in Arctic Exploration.—It has been suggested by Mr. James Gamble, General Superintendent of the Western Union Telegraph Company at San Francisco, that the telegraph might be used to advantage in Arctic exploration. His plan would be to use light steel wire—say number 20 gauge—weighing about twenty pounds to the mile. The wire, coiled on reels, could be hauled on sledges, either by men or dogs, over the snow or ice, paying it out as the advance exploring party went along. By this means the party would keep in constant communication with their base of supplies. They would have no cause for uneasiness about getting lost or beyond the means of rescue, as they would be able at any moment to call for aid. With this feeling of the certainty of relief in case of accident, they would not hesitate to push their explorations to a distance far beyond what would be considered safe in the absence of means of telegraphic communication with the main body. And should any accident happen to the advance party of explorers, or should they require a further quantity of supplies, the line of wire would serve to guide those going to the rescue straight to the spot where the explorers were camped. It would also serve as a guide for their return, materially lessening the chances of danger to life and loss of the party. Having established a base of supplies at some central point, there would be nothing to prevent several exploring parties being sent out at the same time in different directions, they reporting each night to the central station the progress and observations made during the day. Directed in this way the practicability of one route over another could, from the telegraphic reports sent in, be determined upon, and much time that would otherwise be wasted in vain endeavours to make way over barriers of ice, be saved. As hard frozen ground, dry snow, or ice is a perfect insulator, no poles to string the wire would be required. It could be paid out on the snow or ice by the party as they went along. The generally accepted theory of those familiar with the Arctic regions is that the ice is seldom more than five or six feet in thickness, so that by boring through it with a common drill or through the frozen ground, there would be no difficulty in obtaining a good ground connection to complete the electric current. It would not be necessary to carry any battery material. One main battery at the central station only would be required. For a distance of 100 to 150 miles telephones could be used, dispensing with practical telegraph operators. At 20 pounds to the mile, 100 miles of wire would only weigh 2,000 pounds. It could be wound on reels in size easy to handle. The cost of steel wire of that gauge is about 20 cents. a pound, so that the total expense, including cost of reels, winding, &c., would not exceed 1,000 dollars."

Telephones in New Zealand.—Mr. W. Lant Carpenter, of Weymouth, writes to *Nature*, under date 1st June:—"When in Wellington and Dunedin at the end of December last, my opinion was asked by the Government telegraphic officials there upon a pair of ordinary 'Edison-Bell telephones' which they had just received from the United States for purposes of experiment. A careful trial under various conditions showed me that they were very good average instruments of ordinary delivery, such as I had seen hundreds of previously in England and the States. With these instruments, however, Dr. Lemon, the superintendent of the Postal and Telegraph Service, was able to converse clearly between Wellington and Napier over an ordinary land line 232 miles in length while battery currents were passing over the wires on the same posts. In New Zealand telegraphic communication is, and telephonic communication will be, entirely in the hands of the Government. In Melbourne the telephone exchange is worked by a private company, but the erection and maintenance of wires is carried out by the Victorian Government at the annual rate of £5 per subscriber. In Sydney I regret to say nothing was being done in this matter. In Honolulu I found (last January) telephonic communication all over the town, but no telegraphs at all. The King of the Sandwich Islands, however, Alii Kalakana, who is shortly expected in England, told me that he greatly needed submarine cables between the various islands. On my return to England I had the pleasure of sending to Sydney materials for a private telephonic line on sugar plantations in the Fiji Islands, and my friend, Mr. Cobb, manager of the Falkland Islands Company, tells me that the line he took out there at my suggestion is a great success. At Wellington, where the Central N.Z. Telegraph Office is, I was very much struck by the extreme ease with which duplex circuits were worked. Dr. Lemon informed me that it was scarcely necessary to alter the resistances once a week. He showed me a simple little carbon rheostat of his own invention, which appeared to answer admirably; it consisted essentially of two pieces of carbon, the closeness of whose contact was regulated by a screw. On my way home I paid a hurried visit to the central office of the Western Union Telegraph Company in New York, and was greatly surprised to see the extent to which the 16,000 cells in the battery room were being replaced by Siemens dynamo machines. I was told that one of them would 'drive' about fifty wires, and was shown a number of plaster of Paris cylinders, about five inches long and one inch diameter, which were put into circuit to diminish, when necessary, the intensity of the current. It may be remembered that, as a rule, American lines are less perfectly insulated than ours, and hence require stronger currents."

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THE EVOLUTION OF DYNAMO AND MAGNETO ELECTRIC MACHINES.—V.

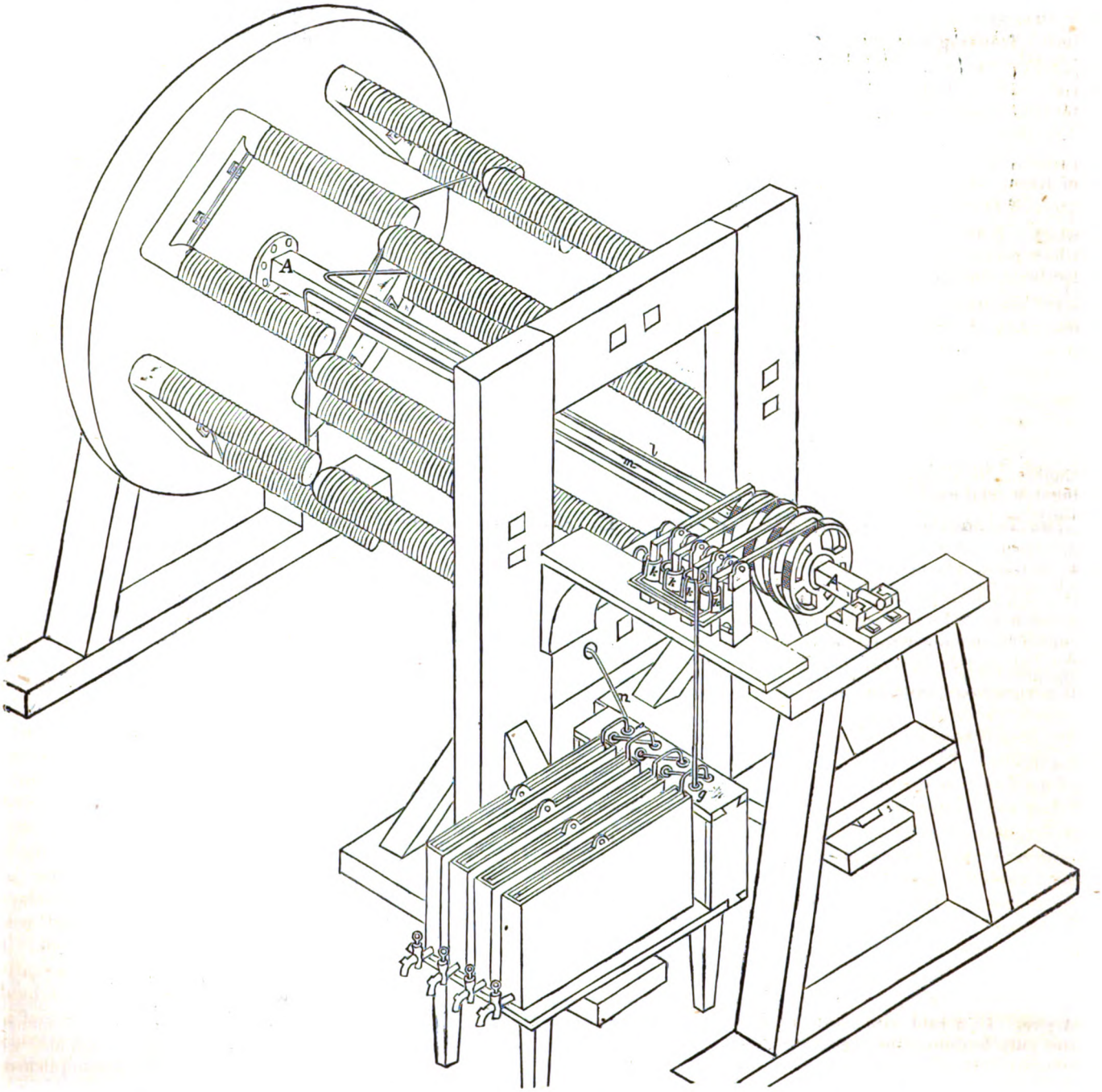
By γ. β.

(CONTINUED FROM PAGE 76.)

In 1834 Professor H. Jacobi, of the University of Dorssal, constructed a magnetic machine for continued circular motion, which was described in a paper sent to the Academy of Sciences at Paris, in November, 1834, but a paper published at Potsdam in 1835 contains not only a description of the machine, but the theoretical reasoning of M. Jacobi on its construction. The description here given is abstracted from the latter paper. The illustration represents the magnetic apparatus of eight bars arranged symmetrically upon a disc movable round the axis A, and of eight fixed bars similarly arranged upon a fixed platform. The arrangement of the bars admits of the greatest variety, provided it be exactly symmetrical, and that it allows the poles to approach each other as nearly as possible. In order to obtain a greater effect, M. Jacobi preferred that the axes of the cylindrical bars should be situated rectangularly, and not parallel, as in the figure, reasoning "that the centre of magnetic gravity is probably at some distance from the extremity, as in the ordinary magnetic bars." Upon these bars so arranged were insulated copper wire helices. Several modifications were introduced into the machines afterwards constructed by M. Jacobi, but the principle remained the same throughout.

A commutator was used to produce the inversion of the poles, and consisted of four copper discs fixed upon the rotating axis. These discs were insulated from the axis by the interposition of varnished wood or other insulating substance, but joined to each other by copper tubes. The periphery of each disc was divided into eight equal parts, of which four were cut out and filled in by pieces of ebony, forming, with the metal, an accurate and smooth surface. The discs were arranged on the rotating axis, so that the sectors of wood and metal alternately correspond, as will be seen by the shaded parts in the figure. Bars of copper, fashioned like levers and very movable on their supports, were used to conduct the current. One end of the arm of the lever rested on the periphery of the corresponding disc, the other end was bent and plunged into a little jar of mercury, k_1 k_1 k_1 k_1. The two outside mercury jars and the two inside jars were connected by strips of copper as shown. The action of the commutator is easily understood. The levers are always in contact with the discs, and rest alternately on the metallic and insulating parts.

The helices surrounding the movable bars were united to form a continuous wire, the ends of which were soldered respectively to the system of discs. The other helices, wound round the



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fixed bars, were also joined, and the one end, *n*, immersed in a jar of mercury attached to the voltaic apparatus, the other in the jar, *k*, of the commutator. Thus, all the sixteen helices form only one connecting wire, through the medium of the commutator.

The voltaic apparatus consisted of four troughs of copper, as shown, in which the zincs were immersed and the whole joined up to form one battery. The direction of the current was reversed each time the poles met, provided the commutator was so placed that the edges of the levers quitted one of the divisions to pass to the other. The inversion acted constantly, and was independent of the velocity of rotation.

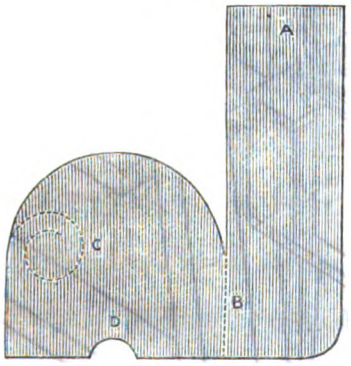
Of this machine, Mr. Preece, in the new edition of *Noad's Student's Text Book*, p. 288, says :—

"The first electro-magnetic engine which was something more than a mere model was constructed by Professor Jacobi, of St. Petersburg, in 1834. In 1838 he succeeded in propelling a boat, containing ten or twelve persons, on the river Neva. The vessel was a ten-oared shallop, equipped with paddle-wheels, to which rotatory motion was communicated by an electro-magnetic engine. The boat was 28 feet long and 7½ feet in width, and drew 2¾ feet of water. At first there was great difficulty in managing the batteries, and the imperfect construction of the engine was a source of frequent interruption. During a voyage which lasted several days the vessel went at the rate of four miles per hour. In 1839 Jacobi tried a second experiment in the same boat. The machine, which was the same as that used on the previous occasion, and which occupied little space, was worked by a battery of 64 platinum plates, each having 36 square inches of surface, and charged, according to the plan of Grove, with nitric and sulphuric acid. The boat, with a party of fourteen persons on board, went *against* the stream at the rate of three miles per hour."

(TO BE CONTINUED.)

ACOUSTIC SINGLE NEEDLE.

Several attempts have been made of late years to give to the single needle instrument acoustical qualities which, besides acting as an alarum, would assist the operator in reading by sound. Until recently, however, all such contrivances have been expensive, and have involved much alteration of the instrument itself. Mr. Barnett, a telegraphist at Aldershot, in the service of the Post Office, has been more successful, the simple device for which he was lately awarded a gratuity of twenty pounds by the Government effecting the desired object in the most inexpensive possible way. By a stroke of inspiration, which is often superior to ingenuity, Mr. Barnett went for, as the Americans say, his object straight away. The ivory pins against which the needle beats did not emit sufficient noise. He, therefore, replaced them with a material that did.



A piece of tin bent into a suitable shape was found to answer this purpose exceedingly well; and this, in fact, is Mr Barnett's simple plan. Our illustration will explain both the shape of this ingenious resonator and the manner in which it is affixed. The two wings A and C are represented, the one (C) curled as used, the other (A) opened out. A can be curled round a bit of lead pencil, and then bent at right angles at the dotted lines B. It will thus occupy a similar position, but opposite to C. By loosening the screws holding the support in which the front needle pivots, and removing the ivory pins, the lower edges can be inserted and secured to the dial. So placed, the tin spirals are struck by the needle when signalling, and a sound, audible at a considerable distance, is obtained. When at rest the needle hangs midway at D. A slight difference in the spirals, either by twisting them differently or stuffing one of them with a bit of paper, will give the necessary distinction between dots and dashes.

CORRESPONDENCE.

WHAT IS ELECTRICITY?

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In the correspondence which formerly appeared in your pages on this subject Mr. Gordon wrote, "Mr. Johnstone credits me with a great deal more knowledge than I either possess or hope to possess for many years to come. If I knew in which direction any current of electricity flows, I should have no need to ask 'what is electricity?' I do not even know whether the flow has a direction at all" (vol. V., p. 259). After getting the information about the direction in which a current of electricity flows, which Mr. Gordon desiderated in the foregoing confession of want of knowledge, it was natural to expect that Mr. Gordon would have shown some esteem for the information when laid before him, but such was not the case. It had the opposite effect of making him drop the correspondence, and now another reader of *The Electrician* has published a book, in which he has repeated Mr. Gordon's erroneous statements about the nature of electricity with a still stronger divergence from the truth than that in Mr. Gordon's book.

The new book is entitled "Electricity." It is a manual for learners, by Fleeming Jenkin, F.R.S., Professor of Engineering in the University of Edinburgh, published under the direction of the Society for Promoting Christian Knowledge. The following is the first paragraph of it:—"Electrical phenomena are described in language which implies the existence of two imponderable fluids called positive and negative electricity. Thus a body exhibiting certain electrical properties is said to contain a *charge* of positive or of negative electricity; we also speak of the *quantity* of electricity with which the body is charged. All bodies are conceived as containing an indefinite amount of a neutral fluid which is not itself electricity, but from which equal quantities of electricity of opposite signs are obtained by decomposition, whenever electricity is brought into evidence. When electricity disappears it is conceived that equal quantities of positive and negative fluid have combined to form the neutral fluid. On any hypothesis the two electricities, inasmuch as they always come into evidence and disappear simultaneously, must be considered as two parts of one phenomenon. It is improbable that either the neutral fluid or the electric fluids have any substantial existence, but the terms used in describing material fluids enable us to describe accurately the electrical properties of matter." On the foregoing I have to remark:—

1st. Faraday maintained that electricity was a force, or rather two forces. Ever since the publication of my experiments in 1839,* I have maintained that electricity is matter of a peculiar kind; but according to the last clause of the above quoted paragraph from Professor Jenkin's book, electricity is neither a force nor is it matter, but is what he calls "electrical properties of matter," and yet at page 14, under the heading *potential*, and elsewhere, he lays before his readers proof that electricity is a something which accomplishes work independently of the matter with which it is in contact.

2nd. The broad assertion that there is a *neutral fluid*, which by decomposition is divided into positive and negative electricity, taken together with the Professor's demonstrations, showing that these two electricities which, when separate, accomplish work which cannot be accomplished by the neutral fluid, must make an impression on every learner's mind, that there is a reality in the existence of these two fluids which will have far more power over the learner's mind than the Professor's saving clause that "It is improbable that either the neutral fluid or electric fluids have any substantial existence." That a something accomplishes work, and that that something has no "substantial existence" is a contradictory statement which should not be laid before learners to confuse their minds.

At page 33, under the heading "Electrical Machines,"

* Particulars of part of these experiments were republished in *The Electrician*, vol. v., p. 268.

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Professor Jenkin states that they are made either cylindrical or plate, of glass or vulcanite, and he describes there that the electricity is collected by points, and passes on to an insulated conductor, and that rubbers are applied for producing friction, and adds, "When vulcanite is used, the negative electricity with which this body is charged by friction flies from its surface to the points and charges the conductor; an equal quantity of positive electricity flows from the rubbers. . . . When glass is used instead of vulcanite, the motion of the electricities is reversed." This description of the action of electricity as issuing from a frictional electrical machine is a repetition of the error I pointed out as existing in Mr. Gordon's book. Professor Jenkin's error is aggravated by his insisting that there is what he calls a neutral fluid, and that by its decomposition, by the motion of the electrical machine producing friction, the neutral fluid is decomposed into positive and negative electricities, which are given out respectively either at the conductor or rubber end of the machine, according as the machine be made of glass or vulcanite. Now, if Professor Jenkin had made use of the insulated coal-gas flame,* the use of which I adopted in 1839, for showing the direction in which a current of electricity moves, he would have seen that his description of the action of the electricity of the electrical machine is not what he has described it to be. Two electricities do not issue from the respective ends of the machine; on the contrary the gas flame shows that when a current of electricity is coming from the machine at one end, a current of electricity is going into it at the other end, instead of, as he says, coming out from it. Therefore it is a gross perversion of fact to assert, as Professor Jenkin has done, that two electricities issue from a frictional machine. This is not teaching Christian knowledge, it is the very opposite; John viii., 44.

The promulgators of the theory of two electricities have for upwards of one hundred years persistently perverted facts which militate against their theory. Professor Jenkin has given us a sample of this on page 21, where he writes "The electric spark consists of white hot matter electrically charged. The disruption of this matter from the body is caused by electric tension. The heat and light observed are due to the mechanical action of disruption, as when a spark is struck by steel from flint." The spark is not electricity," so says the Professor. I believe this opinion has been published before, but I did not expect that it would be repeated by an Engineer, as there is a substantial, practical difference between the two kinds of sparks. On striking a flint with a piece of steel, sparks fly off with a slight hissing sound, the force with which the steel is struck upon the flint produces heat, which is increased by the rapid motion of the hot fragments of steel coming in contact with the oxygen of the air. The person who strikes the steel on the flint will, on examining the steel, easily see that fragments of it have been removed by the flint, but the action of a spark of electricity is altogether different. If a large battery, consisting of a number of electrical jars has its electricity discharged by sparks between two well-polished brass balls, and the process of charging and discharging this battery with electricity be continued for a length of time, yet on examining the brass balls with a microscope, it will be found that no appreciable quantity of the brass has been disrupted, or transferred from the one ball to the other. This is proof that the electric spark is not produced by the disrupted matter of the brass balls, and therefore Professor Jenkin's statement that "an electric spark is not electricity" but "disrupted matter ignited" is not true. Again, Professor Jenkin takes no notice of a remarkable difference in the character of the sound which issues from the two kinds of sparks. That from the steel is a very feeble hissing sound. That from the electric spark, when produced by man, is a sharp crack, and when produced by God it is followed by a peal of thunder. What produces this noise? I answer, it is the matter called electricity which has gone together by its own attraction of cohesion into a mass which rushes through the air with such enormous velocity, that it produces a vacuum by its velocity of motion, and also by its consuming a portion of the air in the course of its line of motion. The air at each side of that line of motion rushes together to fill up the vacuum and makes the crack or peal of thunder.

The electric spark is one of several phenomena, which all lead to the conclusion that electricity is matter, but of a peculiar kind.—Yours, &c.,

JAMES JOHNSTONE.

Experiment Rooms, 1, James-square, Edinburgh,
18th June, 1881.

* The simplest method for using the gas flame for electrical purposes is to procure a yard or two of quarter-inch vulcanized india-rubber tubing. Put one end of it over a gas burner to obtain a supply of gas; into the other end of the tubing put a chemist's glass dropping tube, the wide end of it into the vulcanite tubing. The gas will now issue as a jet from the small hole of the dropping tube. The flame thus insulated, the operator, by holding the flexible tubing in his hand, can with ease apply the flame to any current of electricity to ascertain the direction in which the electricity is moving.

MOZAMBIQUE TO THE FORE!

TO THE EDITOR OF THE ELECTRICIAN.

SIR: A week or two ago I had occasion to erect a short temporary line between the Eastern and South African Telegraph Company's house and station on this island, for the purpose of trying some telephones belonging to the Portuguese Government.

How it came about I cannot explain unless their ancestors did it before them, unless the existence of the rude line of cord which I have been told is used along the banks of the Nile for communication has come to the knowledge of the Makuahs of Eastern Africa, but the day following the erection of our short line across the island I was walking along a street not far from my house, when suddenly I was accosted by half-a-dozen little shiny black boys, their faces all aglow with triumphant pleasure. In one breath they cried to me, "*Um coonyah, mwoenè itoo*," which means, "Look here, Sir." I stood wondering. Presently two of these black little boys ran along the road in opposite directions, dragging after them a long piece of twine. They were laying the line! When they had reached the ends of their tether one of them put up to his very thick lips, and the other to his well-proportioned ear, a superannuated jam tin divested of one end, and with the line connected to the other. Then followed a telephonic conversation, much to the enjoyment of the other black little boys, who immediately proceeded to dance a Makuah hornpipe.

Now, these little boys had not witnessed any of my experiments on the Bell telephone, and it is a wonder to me how they conceived the idea of constructing their toy.

The question naturally arises, Will it pay foreign countries to educate these black little boys, and turn them to some use afterwards? What I have stated above goes to show that education would not, perhaps, be thrown away upon them. But there are many opposite reasons which lead one, after a short residence among them, to arrive at the conclusion that they do not deserve one pennyworth of assistance, unless, indeed, the black man's conscience is a thing yet to be dug up and brought to the surface by the application of education.

At present the little black boys and girls, and the big black men and women—I am talking about the Makuahs and the Moiros—do not suffer from the knowledge that they possess a conscience; therefore, compatible with their own ideas of things in general, they pick and steal and lie with impunity, and go to "bed" at night and snore the sleep of the just on the floors of their mud cabins.—Yours, &c., D.

Mozambique, 27th May, 1881.

ACCIDENT AT BERLIN.—The lobby of the building in which the Reichstag sits is lighted by the electric light, and recently the house-inspector was engaged in superintending the placing of new carbons in one of the globes. As the latter was swinging about, the inspector put out his right hand to steady it, and, touching one of the fine wires which encircle the glass, received an electric shock which stretched him senseless and apparently dead on the floor. He has, it is true, since recovered, but his right side still remains partially paralysed.

TELEGRAPH MATERIALS WANTED.—Tenders are required for the supply of various telegraph stores. Tenders will be received at the Station de Bruxelles Nord (Salle d'Attente des 1st and 2nd classes), on the 13th July, at 11 a.m. Further particulars on application to the Sécrétariat de la Commission de Réception des Postes et Télégraphes à Malines.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice watever will be taken of anonymous communications.*

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DR. SIEMENS' SUGGESTIONS TO GAS MANUFACTURERS.

Whilst it is necessary for us to carefully record the progress made by the electric light in competition with a rival already on the ground, it is just as well that attention should be called now and again to matters connected with the rival light which more directly bear upon this progress. It has been more than once urged that, even if the electric light should supersede gas as a general luminant, the prospects of gas would in no degree suffer, inasmuch as the larger number of engines used to drive the dynamo-machines would be gas engines. This idea became still more prominent when Mr. Swan, in his lecture at Newcastle, stated that by using a certain quantity of gas in a gas engine to drive a dynamo electric machine, which should provide an electric current for his lamps, he was able to obtain a greater volume of light than he could obtain by burning the same quantity of gas in the most approved gas-burner. If this is true—and why should we doubt it when the strongest opponents to the introduction of the electric light have made no sign of doubt?—the gain would be still greater in this particular case if the improvements in gas manufacture suggested by Dr. C. W. Siemens at the late meeting of the British Association of Gas Managers were carried into effect.

The most important improvement with which we shall deal is that the gas given off during the distillation of the coal should be separated, that given off during certain periods of the operation being led to one reservoir, that given off at another period of the operation being led to another reservoir and used for another purpose. Dr. Siemens suggested the addition over each bench of retorts of another collecting pipe, one pipe being set aside for illuminating, and the other for a separate service of heating gas. In his paper Dr. Siemens said :—"I shall be able to prove to you from unimpeachable evidence that the gas coming from a retort varies very greatly in its character during progressive periods of the charge ; that during the first quarter of an hour after closing the retort the gas given off consists principally of marsh gas (CH_4), and other occluded gases and vapour, which are of little or no use for illuminating purposes ; from the end of the first quarter of an hour for a period of two hours rich hydro carbons, such as acetylene (C_2H_2) and olefiant gas (C_2H_4) are given off ; whereas the gases passing away after this consist for the most part, again, of marsh gas, possessing low illuminating power.

"Mr. Ellissen, the late chief of the experimental department of the Paris Gas Works, has favoured me with the result of a most interesting series of experiments, which he carried out in connection with M. Regnault, the eminent physicist, some years ago, the object of the experiments being to discover the proper period of time to be allowed for each charge. . . The results of these experiments showing in a striking manner that, although the average illuminating power produced by the distillation of the coal did not exceed 1·35 carcel burners, or 13·5 standard candles, according to our English mode of measurement, the gas given off from the end of the first quarter of an hour during a period of two hours possessed an illuminating power of 1·616 carcel burners, or 16·16 standard candles." These and other figures quoted would seem to prove the argument, and that the specially collected gas would be better for heating purposes, it being less liable to deposit soot in its combustion upon heat-absorbing surfaces, and in giving weight for weight, a calorific power superior to olifiant gas.

The question at once arises, would not the gas intended specially for heating purposes be still more economical than the mixed gas now burnt in the gas engines? Dr. Siemen's further suggestions related to the use of the regenerative furnace in connection with the retort benches, also an additional retort to each bench, and the quicker distillation of the coal, suggestions which, if carried out, would still more tend to the econimical production of the material.

The discussion upon this paper was extremely interesting to those engaged directly or indirectly with electric light operations, as it clearly brought out the thought that seems uppermost in the minds of those engaged in the gas manufacture. One speaker said, "As they were aware, electricity was now the great rival of gas, and it was making headway." Another said, "He felt that the electric light was the light of the future ; therefore, he recommended cheaper gas, and more attention to the bye-products." But the most important part of the discussion, from a practical point of view, centered around the question of the cost which the adoption of these suggestions would entail. It would be necessary for the distribution of the gases to have a double set of apparatus, special gasometers to store respectively the heating and the illuminating gas, special mains for their distribution, special meters for their measurement, and so on. The majority of speakers seemed to think that this presented an insuperable difficulty, and that it would be impossible to obtain any return upon the capital required in the first place to erect and lay down the plant. In his reply, Dr. Siemens very

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pertinently remarked, "The question of the cost of plant, of which Mr. Hartley and several others had made a point, he could not accept. If an engineer wanted to construct a railway, he did not inquire what had been the traffic by the stage-coach during the last twenty years, but what were the capabilities of developing a traffic. Now, with public feeling alive to the importance of heating gas, and with the public clamour for gas of a higher illuminating power, it was for gas companies to supply gas of this higher illuminating power, although it might be at increased cost. Similarly they ought to develop other means of supply, in order to meet the demand for heating gas."

We have no objection to increased economy in the production of gas, inasmuch as the probability of the more economical production of electricity is greater; and even if it were not, the electric light is certain to progress on other than economical grounds. We trust the gas engineers will carefully consider the arguments brought forward by Dr. Siemens, and will see their way to carry out the admirable suggestions he made.

UPON A MODIFICATION OF WHEATSTONE'S MICROPHONE, AND ITS APPLICABILITY TO RADIOPHONIC RESEARCHES.*

In August, 1880, I directed attention to the fact that thin discs or diaphragms of various materials become sonorous when exposed to the action of an intermittent beam of sunlight, and I stated my belief that the sounds were due to molecular disturbances produced in the substance composing the diaphragm†. Shortly afterwards Lord Raleigh undertook a mathematical investigation of the subject, and came to the conclusion that the audible effects were caused by the bending of the plates under unequual heating‡. This explanation has recently been called in question by Mr. Preece§, who has expressed the opinion that, although vibrations may be produced in the discs by the action of the intermittent beam, such vibrations are not the cause of the sonorous effects observed. According to him, the aerial disturbances that produce the sound arise spontaneously in the air itself by sudden expansion due to heat communicated from the diaphragm, every increase of heat giving rise to a fresh pulse of air. Mr. Preece was led to discard the theoretical explanation of Lord Raleigh on account of the failure of experiments undertaken to test the theory.

He was thus forced—by the supposed insufficiency of the explanation—to seek in some other direction the cause of the phenomenon observed, and as a consequence he adopted the ingenious hypothesis alluded to above. But the experiments which had proved unsuccessful in the hands of Mr. Preece were perfectly successful when repeated in America under better conditions of experiment, and the supposed necessity for another hypothesis at once vanished. I have shown in a recent paper read before the National Academy of Science|| that audible sounds result from the expansion and contraction of the material exposed to the beam; and that a real to and fro vibration of the diaphragm occurs capable of producing sonorous effects. It has occurred to me that Mr. Preece's failure to detect with a delicate microphone the sonorous vibrations that were so easily observed in our experiments might be explained upon the supposition that he had employed the ordinary form of Hughes's microphone, shown in Fig. 1, and that the vibrating area was confined to the central portion of the disc. Under such circumstances it might easily happen that both the supports A, B, of the microphone might touch portions of the diaphragm which were practically at rest. It would, of course, be interesting to ascertain whether any such localisation of the vibration as that supposed really occurred, and I have great pleasure in showing to you to-night the apparatus by means of which this point has been investigated (see Fig. 2).

The instrument is a modification of the form of microphone devised in 1827 by the late Sir Charles Wheatstone, and it consists essentially of a stiff wire, A, one end of which is rigidly attached to the centre of a metallic diaphragm B. In Wheatstone's original arrangement the diaphragm was placed directly against the ear, and the free extremity of the wire was rested against some sounding body, like a watch. In the present arrangement the diaphragm is clamped at the circumference like a telephone-diaphragm, and the sounds are conveyed to the ear through a rubber hearing-tube, C. The wire passes through the perforated handle D, and is exposed only at the extremity. When the point A was rested against the centre of a diaphragm upon which was focussed an intermittent beam of sunlight, a clear musical tone was perceived by applying the ear to the hearing tube C. The surface of the diaphragm was then explored with the point of the microphone, and sounds were obtained in all parts of the illuminated area, and in the corresponding area on the other side of the diaphragm. Outside of this area, on both sides of the diaphragm, the sounds became weaker and weaker, until at a certain distance from the centre they could no longer be perceived.

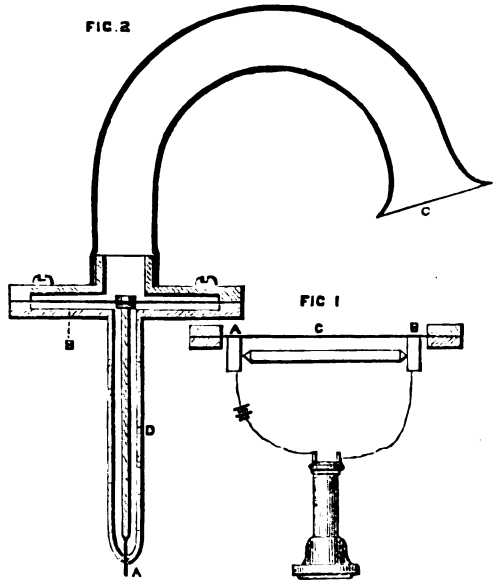

FIG. 1. A B, carbon supports; C, diaphragm. FIG. 2. A, stiff wire; B, diaphragm; C, hearing tube; D, perforated handle.

At the points where one would naturally place the supports of a Hughes microphone (see Fig. 1) no sound was observed. We were also unable to detect any audible effects when the point of the microphone was rested against the support to which the diaphragm was attached. The negative results obtained in Europe by Mr. Preece may, therefore, be reconciled with the postive results obtained in America by Mr. Tainter and myself. A still more curious demonstration of localisation of vibration occurred in the case of a large metallic mass. An intermittent beam of sunlight was focussed upon a brass weight (1 kilogram), and the surface of the weight was then explored with the microphone shown in Fig. 2. A feeble but distinct sound was heard upon touching the surface within the illuminated area and for a short distance outside, but not in other parts.

In this experiment, as in the case of the thin diaphragm, absolute contact between the point of the microphone and the surface explored was necessary in order to obtain audible effects. Now, I do not mean to deny that sound waves may be originated in the manner suggested by Mr. Preece, but I think that our experiments have demonstrated that the kind of action described by Lord Raleigh actually occurs, and that it is sufficient to account for the audible effects observed.

* A paper read before the Philosophical Society of Washington, D.C., June 11, 1881, by Alex. Graham Bell.
† Amer. Ass. for Advancement of Science, Aug. 27, 1880.
‡ *Nature*, Vol. XXIII., p. 274.
§ Roy. Soc., Mar. 10, 1881.
|| April 21, 1881.

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THE TREASURY AND THE TELEGRAPH CLERKS.

The telegraph clerks in the service of the English Post Office are now contemplating, if not enjoying, the fruits of their agitation. We can neither congratulate nor condole with them on their achievement, for nobody but the agitators themselves can say whether they ought to be satisfied or not. But as regards some of the consequences of their action—consequences which are foreshadowed in the Treasury minute dated 16th inst., and addressed to the Postmaster-General—we, in common with average mortals possessed of non-official intelligence, have formed a very distinct opinion, and one which is the reverse of complimentary to the framer or framers of that extraordinary document. Those consequences, if allowed to ensue, will materially affect the welfare of the telegraph service in this country, and for that reason we regard it as our duty to comment upon them freely.

In our last week's issue we printed at full length the minute referred to, and we will now ask our readers to reperuse with us a few of its choicest utterances. After stating that my Lords of the Treasury accept all Mr. Fawcett's proposals "for improving the pay and general position of the telegraphists and sorting clerks," and hinting at the struggle my Lords have gone through to part with the needful charges—a struggle which it would have been more seemly not to have mentioned if the charges are just, and more manly to have resisted if the charges were unjust—their Lordships proceed to say, "nor (*sic.*) can they shut their eyes to the means by which the claims for this improvement have been urged upon the Government by a part of the officers interested." Having thus refused to shut their eyes, my Lords at once, and contrary to nursery precedent, open their mouths, and this is what they send us:—"Admitting, as my Lords do, that when discontent prevails it calls for redress if well founded, they are not prepared to acquiesce in any organised agitation which openly seeks to bring its voting power to bear on the House of Commons against the Executive Government." This passage is suggestive of many things. It is a saddening reflection on the House of Commons itself, whose members are here assumed to be guilty of weakness and frailty, to which, of course, my Lords are quite superior. It is an instructive comment, too, upon voting in general, upon the value of votes, and especially upon "openly" bringing votes to bear upon anybody. It ought apparently to be done in secret, or through the pure channel of the caucus. But what we are most curious to know is, whether such an organised agitation, openly seeking to influence through its voting power, has been going on. If it has, then it is plain that my Lords have "acquiesced" in it. If it has not, then my Lords have gratuitously suggested a course which all whom it may concern will not be slow to follow. Indeed, my Lords go much out of their way to show how the thing may be worked. "Other branches," we are informed, "of the Civil Service employed (and voting) in various parts of the United Kingdom are at least as numerous in the aggregate as the servants of the Post Office." That is to say there are about 20,000 such persons spending their time in being "employed (and voting)." This is bad enough, but worse is to come. "All this vast number of persons, not living like soldiers or sailors outside ordinary civil life, are," it appears, "individually and collectively interested in using their votes to increase, in their own favour, the public expenditure, which the rest of the community, who have to gain their living in the unrestricted competition of the open market, must provide by taxation, if it is provided at all." We sincerely commisserate the respectable nobleman whose signature had to be appended to this precious discovery. It may be a bad thing for civil servants to have votes like other people; and it may be a bad thing that other people, besides civil servants, who are interested in using their votes in their own favour have any votes to use; but whether good or bad, the facts are by no means new, and seeing that most modern Governments reckon to live and thrive on these electoral phenomena, the present Government can hardly be ignorant of their existence. The "public expenditure," we had thought, has been pretty considerably increased of late years by people, not civil servants, looking after their own interests, and encouraged to do so by even my Lords in their Parliamentary capacity. The British workman has taxed us freely enough in all conscience, while the Treasury have looked on with composure. Nor, in respect to this particular class of "public expenditure," have we had any assurance that it was just and reasonable. With regard to the telegraphists, on the other hand, we have this assurance from the very highest authority, the Postmaster-General himself. In the minute to which that of the Treasury upon which we are commenting is a reply, Mr. Fawcett says, "feeling convinced that the rates of pay which I propose are not more than sufficient to afford just and reasonable remuneration to those on whose efficiency and contented service so much of the interests and convenience of the community depend, I confidently submit the scheme for your Lordships' approval."

To deal rationally with such a proposal, backed by such recommendation, two courses were open; it could be wholly or partially refused, or it could be acceded to with a good grace. But for a certain class of statesmen nothing less than three courses will serve, and the Treasury have blundered on the third. They accept the proposal in its entirety, but the clerks are to be punished for getting it accepted. In other words, my Lords admit the grievances, and acknowledge as plainly as words can speak that they would not have admitted any grievances at all unless they had been obliged, yet they are indignant at being reluctantly compelled to redress them. The passage we have quoted plainly threatens disfranchisement; and further on we are informed that the Government is anxious to know whether an existing Act, making "breaches of contract of service" a penal offence, can be strained so as to reach the telegraphist. Something may be said both for disfranchisement and for binding contract. But nothing can or ought to be said for a bargain which binds one party who has not been consulted and leaves the other free. Yet this is practically what the Treasury is driving at; and what is worse, its object is blurted out just at the time when conciliatory language was most needed.

Having thus done their utmost not to earn any gratitude for their concession, my Lords forthwith saddle it with a condition which positively invites hostility. "The terms agreed to [by the Treasury] may be suspended in any Post-office of which the members are henceforth known to be taking part in extra-official agitation." This is very much like scrambling hot coppers by way of paying a just debt, and scraping them in again if the creditor does not snatch them up and look pleasant. What is extra-official agitation? Or, rather, what is an agitation that is not extra-official? We are inclined to think that the telegraphists ought to be satisfied with what they have got; but from the Treasury point of view they ought to have been content with what they had; and as they have not obtained nearly all they asked for, on what plea, we should like to know, is the Treasury entitled to have the last word? On one point we agree with the Treasury and with Mr. Fawcett. The telegraph clerks, or telegraphists, had no special claim under the Playfair scheme. Probably their reason for imagining they had such a claim was the construction naturally put upon the words "officers and clerks," under which heading they were admittedly designated in the Telegraph Act of 1868. It will be news to them, as it certainly is to us, that sortists—or sorters—come under this heading also—at all events in the correspondence now before us; and the question naturally arises, if letter-sorters why not letter-carriers? This opens up a further question. What are those "privileges" which were specifically bestowed upon the telegraphist when he entered the Post Office service, and which were to be enjoyed by him in common with "officers and clerks in the permanent Civil Service of the Crown?" The answer will obviously turn upon what was meant by "officers and clerks" in the year 1868. Would it be extra-official agitation in 1881 to try to ascertain what that definition was? and what those privileges were deemed to be thirteen years ago? Whatever the answer on further investigation may prove to be, we can be certain that it was never intended that the telegraphists should be ranked any-

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how, or that they should have those privileges arbitrarily curtailed without their being parties to the understanding. We fear that there will be no contented and, consequently, no efficient telegraph service until the bad impression which this Treasury minute has made is removed.

ON THE MODERN DEVELOPMENT OF FARADAY'S CONCEPTION OF ELECTRICITY.*

BY PROFESSOR HELMHOLTZ.

(CONTINUED FROM PAGE 94.)

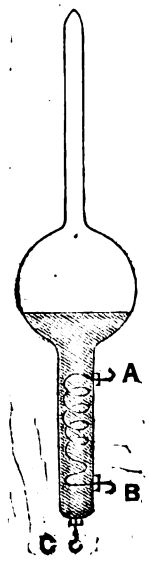
In the beginning Berzelius and the adherents of Volta's original theory of galvanism, based on the effects of metallic contact, raised many objections against Faraday's law.

By the combination of Nobili's astatic pairs of magnetic needles with Schweigger's multiplier, a coil of copper wire with numerous circumvolutions, galvanometers became so delicate that they were able to indicate the electro-chemical equivalent of currents, so feeble as to be quite imperceptible by all chemical methods, with the newest galvanometers. You can very well observe currents which would require to last a century before decomposing one milligram of water, the smallest quantity that is usually weighed in chemical balances. You see that if such a current lasts only some seconds or some minutes, there is not the slightest hope of discovering its products of decomposition by chemical analysis. And even if it should last a long time, the minute quantities of hydrogen collected at the negative electrode may vanish, because they combine with the traces of atmospheric oxygen absorbed by the liquid. Under such conditions a feeble current may continue as long as you like without producing any visible trace of electrolysis, not even of galvanic polarisation, the appearance of which can be used as an indication of previous electrolysis. Galvanic polarisation, as you know, is an altered state of the metallic plates which have been used as electrodes during the decomposition of an electrolyte. Polarised electrodes, when connected by a galvanometer, give a current which they did not give before being polarised. By this current the plates are discharged again and returned to their original state of equality. The most probable explanation of this polarisation is that molecules of the electrolyte, charged with electricity, are carried by the current to the surface of the metal, itself charged with opposite electricity, and are retained there by electric attraction. That really constituent atoms of the electrolyte partake in the production of galvanic polarisation cannot well be doubted, because this state can be produced and also destroyed purely by chemical means. If hydrogen has been carried to an electrode by the current, contact with the atmospheric oxygen removes the state of polarisation.

The depolarising current is, indeed, a most delicate means of discovering previous decomposition. But even this may fail if the nascent polarisation is destroyed by an intervening chemical action like that of the oxygen of the air. To avoid this, delicate experiments on this subject cannot be performed except in vessels carefully purified of all gases. I have lately succeeded in doing this in a far more perfect way than before, by using the hermetically sealed cell (Fig. 1), which contains water acidulated with sulphuric acid. Two platinum wires, B, &c., and a third platinum wire, A, which in the interior is connected with a spiral of palladium, can be used as electrodes. The tube, before it had been closed, was connected with a water pump, and at the same time oxygen was evolved from B and C by two Groves elements; the hydrogen carried to the palladium wire, A, was occluded in the metal. In this way the liquid in the tube is wasted out with oxygen under low pressure, and freed from all other gases. After the closing of the tube, the remaining small traces of electrolytic oxygen combine slowly with the hydrogen of the palladium. Traces of hydrogen occluded in the platinum wires, B and C, can be transferred by a feeble electromotive force into the palladium; and even new quantities of electrolytic gases, evolved after closing the tube, can be removed again by a Daniell's cell, which carries hydrogen to the palladium, where it is occluded, and oxygen to B and C, where it combines with hydrogen, as long as traces of this gas are dissolved in the liquid. The rest of the oxygen absorbed by the liquid combines with the occluded hydrogen. I have ascertained with this apparatus that under favourable conditions one can observe the polarisation produced during a few seconds by a current which would decompose only one milligram of water in a century. But even if the appearance of galvanic polarisation should not be acknowledged by opponents as a sufficient indication of previous decomposition, it is not difficult at present to reduce the indications of a good galvanometer to absolute measure, and to calculate the amount of decomposition which ought to be expected according to Faraday's law, and to verify that in all the cases in which no products of electrolysis can be discovered, their amount is too small for chemical analysis.

Products of decomposition cannot appear at the electrodes without the occurrence of motions of the constituent molecules of the electrolyte throughout the whole length of the liquid. On this point the majority of Faraday's predecessors were already agreed, but they differed from each other as soon as they came to the question what those motions were. Faraday saw very clearly the importance of this problem, and again appealed to experiment. He filled two cells with an electrolytic fluid, connecting them by a thread of asbestos wetted with the same fluid, in order to determine separately the quantity of all the chemical constituents transferred to the one and the other extremity of the electrolytic conductor. You know that he proposed for these atoms or groups of atoms transported by the current through the fluid the Greek word "Ions," the "Travellers," and comparing the current of positive electricity with a stream of water, he called "cations" those atoms which went down the stream in the same direction with the positive electricity to the cathode, the metallic plate through which this electricity left the fluid. The "anions," on the contrary, go up the stream to the anode, the metal plate which is the source of the current of + E. Cations generally are atoms which are substitutes of hydrogen; anions are halogens.

FIG. 1.



This subject has been studied very carefully and for a great number of liquids, by Professor Hittorff, of Münster, and Professor G. Wiedemann, of Leipsic. They found that generally the velocity of the cation and the anion is different. Professor F. Kohlrausch, of Würzburg, has brought to light the important fact that in diluted solutions of salts, including hydrates of acids and hydrates of caustic alkalis, every ion under the influence of currents of the same density moves on with its own peculiar velocity, independently of other ions moving at the same time in the same or in opposite directions.

Among the cations hydrogen has the greatest velocity; then follow potassium, ammonium, silver, sodium; afterwards the bivalent atoms of barium, copper, strontium, calcium, magnesium, zinc; near to the latter appears univalent lithium. Among the ions hydroxyl (OH) is the first, then follow the other univalent atoms iodine, bromine, cyanogen, chlorine, the compounds NO_3, ClO_3, the bivalent halogens of sulphuric and carbonic acid; after these fluorine and the halogen of acetic acid ($C_2H_3O_2$). The only exception to this rule is the difference observed between the decomposition of univalent and bivalent compounds. Generally the velocity of any ion when separated from a bivalent mate is less than when separated from one or two univalent mates. It seems possible that the majority of molecules SO_4H_2 may be divided electrolytically into SO_4 and H_2, some of them on the other hand into SO_4H and H. By the latter some hydrogen would be carried backwards, and therefore the velocity of the total amount might appear diminished. If both ions are moving, we shall find liberated at each electrode (1) that part of the corresponding ion which has been newly carried to that side; (2) another part which has been left by the opposite ion with which it had been formerly combined. The

* From the *Chemical Society's Journal*.

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total amount of chemical motion in every section of the fluid is, therefore, represented by the sum of the equivalents of the cation gone forwards, and of the anion gone backwards, in the same way as in the dualistic theory of electricity, the total amount of electricity flowing through a section of the conductor corresponds to the sum of positive electricity going forward, and of negative electricity going backwards.

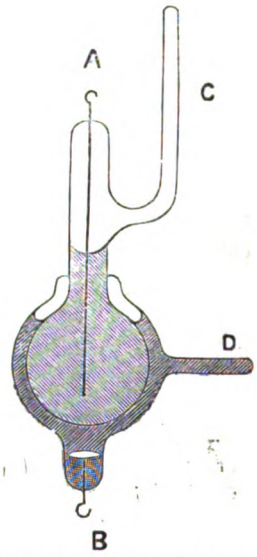
This established, Faraday's law tells us that through each section of an electrolytic conductor we have always equivalent electrical and chemical motion. The same definite quantity of either positive or negative electricity moves always with each univalent ion, or with every unit of affinity of a multivalent ion, and accompanies it during all its motions through the interior of the electrolytic fluid. This quantity we may call the electric charge of the atom.

I beg to remark that hitherto we have spoken only of phenomena. The motion of electricity can be observed and measured. Independently of this, the motion of the chemical constituents can also be measured. Equivalents of chemical elements and equivalent quantities of electricity are numbers which express real relations of natural objects and actions. That the equivalent relation of chemical elements depends on the pre-existence of atoms may be hypothetical; but we have not yet any theory sufficiently developed which can explain all the facts of chemistry as simply and as consistently as the atomic theory developed in modern chemistry. Now, the most startling result of Faraday's law is perhaps this. If we accept the hypothesis that the elementary substances are composed of atoms, we cannot avoid concluding that electricity, also, positive as well as negative, is divided into definite elementary portions, which behave like atoms of electricity. As long as it moves about on the electrolytic liquid, each ion remains united with its electric equivalent or equivalents. At the surface of the electrodes decomposition can take place if there is sufficient electromotive force, and then the ions give off their electric charges and become electrically neutral. The same atom can be charged in different compounds with equivalents of positive or of negative electricity. Faraday pointed out sulphur as being an element which can act either as anion or as cation. It is anion in sulphide of silver, a cation, perhaps, in strong sulphuric acid. Afterwards he suspected that the deposition of sulphur from sulphuric acid might be a secondary result. The cation may be hydrogen, which combines with the oxygen of the acid, and drives out the sulphur. But if this is the case, hydrogen recombined with oxygen to form water must retain its positive charge, and it is the sulphur which in our case must give off positive equivalents to the cathode. Therefore, this sulphur of sulphuric acid must be charged with positive equivalents of electricity. The same may be applied to a great many other instances. Any atom or group of atoms which can be substituted by secondary decomposition for an ion must be capable of giving off the corresponding equivalent of electricity.

When the positively charged atoms of hydrogen or any other cation are liberated from their combination and evolved as gas, the gas becomes electrically neutral; that is, according to the language of the dualistic theory, it contains equal quantities of positive and negative electricity; either every single atom is electrically neutralised, or one atom, remaining positive, combines with another charged negatively. This latter assumption agrees with the inference from Avogrado's law, that the molecule of free hydrogen is really composed of two atoms. Now arises the question:—Are all these relations between electricity and chemical combination limited to that class of bodies which we know as electrolytes? In order to produce a current of sufficient strength to collect enough of the products of decomposition without producing too much heat in the electrolyte the substance which we try to decompose ought not to offer too much resistance to the current. But this resistance may be very great, and the motion of the ions may be very slow; so slow, indeed, that we should need to allow it to go on for hundreds of years before we should be able to collect even traces of the products of decomposition; nevertheless, all the essential attributes of the process of electrolysis could subsist. In fact, we find the most various degrees of conducting power in various liquids. For a great number of them, down to distilled water and pure alcohol, we can observe the passage of the current with a sensitive galvanometer. But if we turn to oil of turpentine, benzene, and similar substances, the galvanometer becomes silent. Nevertheless, these fluids, also, are not without a certain degree of conducting power. If you connect an electrified conductor with one of the electrodes of a cell filled with oil of turpentine, the other with the earth, you will find that the electricity of the conductor is discharged unmistakably more rapidly through the oil of turpentine than if you take it away and fill the cell only with air. We may in this case also observe polarisation of the electrodes as a symptom of previous electrolysis. Connect the two pieces of platinum in oil of turpentine with a battery of eight Daniell's, let it stay 24 hours, then take away the battery, and connect the electrodes with a quadrant electrometer, it will indicate that the two surfaces of platinum, which were homogeneous before, produce an electromotive force which deflects the needle of the electrometer. The electromotive force of this polarisation has been determined in some instances by Mr. Picker in the Laboratory of the University of Berlin. He has found that the polarisation of alcohol decreases with the proportion of water which it contains, and that that of the purest alcohol, ether and oil of turpentine, is about 0·3, that of benzene 0·8 of a Daniell element.

Another sign of electrolytic conduction is that liquids placed between two different metals produce an electromotive force. This is never done by metals of equal temperature, or by other conductors which, like metals, let electricity pass without being decomposed. The production of an electromotive force is observed even with a great many rigid bodies, although very few of them allow us to observe electrolytic conduction with the galvanometer, and even these only at temperatures near their melting points. I remind you of the galvanic pile of Zamboni, in which pieces of dry paper are intercalated between thin leaves of metal. If the connection lasts long enough, even glass, resin, shellac, paraffin, sulphur—the best insulators we know—do the same. It is nearly impossible to prevent the quadrants of a delicate electrometer from being charged by the insulating bodies by which they are supported.

FIG. 2.



In all the cases which I have quoted, one might suspect that traces of humidity absorbed by the substances or adhering to their surface were the electrolytes. I show you, therefore, this little Daniell cell, Fig. 2, constructed by my former assistant, Dr. Giese, in which a solution of sulphate of copper with a platinum wire, A, as an electrode, is enclosed in a bulb of glass hermetically sealed. This is surrounded by a second cavity, sealed in the same way, which contains a solution of zinc sulphate and some amalgam of zinc, to which a second platinum wire, *b*, enters through the glass. The tubes C and D have served to introduce the liquids, and have been sealed afterwards. It is, therefore, like a Daniell cell in which the porous septum has been replaced by a thin stratum of glass. Externally all is symmetrical at the two poles; there is nothing in contact with the air but a closed surface of glass, through which two wires of platinum penetrate. The whole charges the electrometer exactly like a Daniell cell of very great resistance, and this it would not do if the septum of glass did not behave like an electrolyte, for a metallic conductor would completely destroy the action of the cell by its polarisation. All these facts show that electrolytic conduction is not at all limited to solutions of acids or salts. It will, however, be rather a difficult problem to find out how far the electrolytic conduction is extended, and I am not yet prepared to give a positive answer. What I intended to remind you of was only that the faculty to be decomposed by electric motion is not necessarily connected with a small resistance to the current. It is easier for us to study the cases of small resistance, but the illustration which they give us about the connection of electric and chemical force is not at all limited to the acid and saline solutions usually employed.

(TO BE CONTINUED.)

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PHYSICAL SOCIETY.—June 25, 1881.

Professor Fuller in the chair. Senor Olympio de Barcelos elected a member.

Electro Dynamic Induction.

Mr. Grant exhibited an apparatus for showing the position and direction of the curve of zero electro-dynamic induction. It consisted of two coils of insulated wire mounted on stands, one being fixed, while the other was free to revolve round it at a fixed distance.

The Index of Refraction for Ebonite.

Professor W. E. Ayrton explained the determination of the refractive index of ebonite made by himself and Professor Perry. The result for oxyhydrogen light was 1·7; but at the suggestion of Professor FitzGerald, of Dublin, this was checked by measuring the polarising angle of ebonite by reflected light. Sunlight was employed in these experiments and different pieces of ebonite. The result was 1·611. Professors Ayrton and Perry had repeated their former experiments, using the electric light and a battery of 70 volts E.M.F. The result confirmed the one first obtained. They had also determined the index of refraction in the ordinary way from the red rays which they observed to pass through the prism of ebonite. Result for the least refrangible rays 1·66. Mr. Boys remarked that one could see better through thin ebonite if it was varnished or wetted than when not so treated.

The British Association.

A letter was read by the Chairman from a sub-committee of the British Association, inviting the members of the society to send exhibits to the jubilee meeting of the B.A. at York.

The Microphonic Action of Selenium Cells.

Dr. James Moser read a paper "On the Microphonic Action of Selenium Cells," in which he argued that the action of the selenium cell in the photophone was that of a microphonic contact or bad joint between the metal electrodes or metal plates of the cell and the selenium. The heat rays of the photophonic beam caused the joint to expand and contract, hence the variation in the current passing through the receiving telephone. Dr. Moser also exhibited a piece of selenium which increased, not diminished, in electric resistance when light fell upon it.

A Standard Daniell Cell.

He further showed a standard Daniell cell of the gravity type, which consisted of a glass vessel, containing the copper plate at the bottom immersed in sulphate of copper solution, and the zinc plate at the top immersed in sulphate of zinc solution, and a clear line of demarcation between these solutions was produced by suspending an independent piece of zinc midway between the plates, so as to decompose all the sulphate of copper which diffused upward to that point.

Professor Macleod said that he had produced the same result by surrounding the zinc plate with a cage of copper wire connected to the copper plate. Copper deposited on the cage, and the cell was in constant use. Dr. Lodge said that arrangement would not, however, serve as a standard of electromotive force, because all the copper plate should be in the copper solution. In his cell the copper and solution are both in a test tube immersed in the zinc solution, and diffusion has to take place up this test tube and down the cell, so as to enter a second tube open at the bottom in which the zinc is placed.

A Novel Experiment.

Dr. Guthrie showed a new experiment to the effect that when a magnet is suspended over a disc of copper, and the disc is rotated, the magnet is repelled upwards. The experiment was shown by suspending a horseshoe magnet from one end of a scale beam counterweighted. As a possible explanation he suggested that the vertically resolved force of the induction current before the magnet might be greater than that behind the magnet.

Specific Heats.

The Secretary read a paper by Professor Balfour Stewart and Mr. W. Strode "On Results Obtained by a Modification of Bunsen's Calorimeter," described to the society in January last year. With a new instrument made by Casella they have determined the mean specific heat of iron to be 0·1118, and that of sulphur 0·1756, the true values being given as 0·1138 and 0·1776. The advantage of the method is its simplicity, and the fact that very small quantities of the substance may be used.

Heating a Daniell Cell.

Dr. Lodge then explained experiments by Mr. Sutherland, showing that a Daniell cell keeps its E.M.F. very constant when heated, because the thermo-electric effect at the junction of the zinc with the solution is balanced by that at the junction of the copper with the solution.

After remarks by Dr. Moser and Professor Perry, the society separated until November next.

SELF-REGISTERING TARGET.

We give herewith illustrations showing a design for a target invented by Lieut. Finney, Hazel-grove, Stockport, intended to fulfil the desirable object of registering the hits in competitive rifle shooting, so as to prevent the possibility of foul play.

Fig. 1 shows the section, and Fig. 2 the general arrangement in front elevation. The target is divided up into parts, each part or segment being suspended on rollers—F F in Fig. 1. In Fig. 2 these are shown, but would of course only be visible at the rear—each part being balanced by a plate (C in Fig. 1). On each segment is a projecting rod K, passing through a supporting frame D, and with a head H. An electric circuit, broken by means of a spiral spring G, which keeps the target and rod forward on its rollers, so that it is separated from H, to which are fixed electric connections, so as to complete the circuit whenever the target segment is pressed back, compressing the spiral spring, and causing H and H¹ to come into contact with each other. This is intended to be effected by the impact of the bullet, so that whichever portion of the target is struck a certain electric circuit is completed, and a corresponding signal is made.

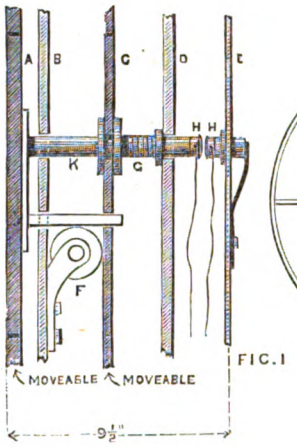

FIG. 1

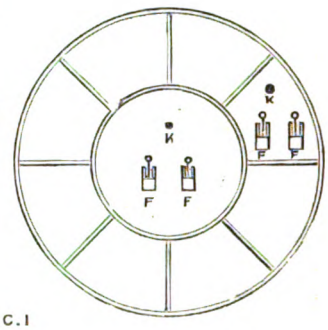

FIG. 2

It may be well to point out, however, that it is very questionable in our judgment if this would act without some modification. Probably in some form it might be a great success. As designed the impact of the bullet has to move a heavy weight on rollers, and compress a spiral spring which need not be opposite, but may be laterally several inches distant from the point of impact. At Enfield there exists a target for registering the moment of impact, which is on a somewhat similar principle. In that, however, the target is suspended, and the spring employed so light that the merest touch moves it. The target vibrates rather than swings, and this arrangement acts so well that the superintendent of the Royal Laboratory is making a similar one to test velocities on the range in the Royal Arsenal. Obviously, therefore, the possibility exists of perfecting the idea suggested for the registration of place of impact, though we think the present form would need modification.—*Engineer*.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices June 20.		Business Done Week Ending June 29. Highest.	Lowest.
Anglo-American	53¾,	⅛	54	52¾
Do. Preferred	84,	85	86	84½
Do. Deferred	24¼,	25½	26	24¼
Brazil Submarine	10½,	¾	10⅞	10⅜
Cuba	9½,	⅜	—	—
Do. Preference	16¾,	17	—	—
Direct Spanish	4⅛,	5	4⅞	4 11-16
Do. Preference	13½,	14½	—	—
Direct United States Cable	10⅛,	⅜	10⅞	10⅞
Eastern Telegraph	10⅜,	⅜	10⅞	10⅞
Do. 6 per Cent. Preference	12½,	13½	13	13
Do. 5 per Cent. Debentures, 1899	106,	109	108	107
Eastern Extension	11⅛,	⅜	11⅛	11⅛
German Union	11⅛,	⅜	11⅛	11⅛
Globe Telegraph and Trust Company	6⅛,	¼	6⅛	6 5-16
Do. Preference	12⅜,	⅝	12⅞	12⅝
Great Northern	13½,	¾	13¾	13¾
Indo-European	28,	29	—	—
Mediterranean Extension	2½,	3	—	—
Do. Preference	9½,	¾	—	—
Reuter's	11,	12	11⅛	11⅛
Submarine	280,	290	—	—
West India and Panama	2,	¼	2⅛	2⅛
Do. 1st Preference	7½,	8	7⅞	7⅞
Western Brazilian	8½,	9	9⅛	8 9-16
West. Union 7 per Cent. 1st Mortgage	123,	128	—	—
Do. 6 per Cent. Sterling Bonds	106,	110	—	—

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RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

4049. Improvements in Dynamo and Magneto-Electric Machines, *A. W. L. Reddie.—Dated 5th October*, 1880.—(*A communication from Messrs. Biloret and Mora.*) 6*d*.

The inventors wish to obtain two or more circuits in one machine, also more efficient armatures. The wires surrounding the field magnets are connected at one end in a group to one of the brushes of the commutator, the other ends being connected with separate circuits, and led to the

4049 FIG. 1

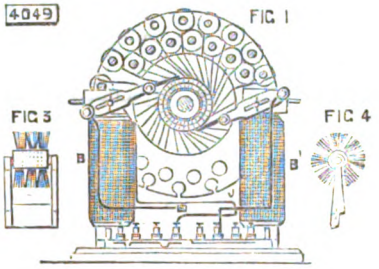
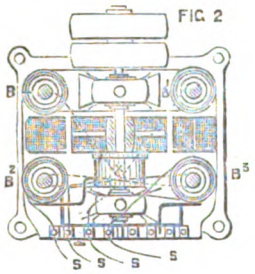


FIG. 2



other commutator brush. The bobbins forming the armature are placed between two discs of iron, and connected thereto by their ends. B B are the bobbins, J J the iron discs. In Fig. 2 B^1 B^2 B^3 show the field magnets. The inner ends of the wires are grouped at X; the outer ends to the bending screws S S S S.

4267. Improvements in Galvanic Batteries, *R. C. Anderson.—Dated 20th October*, 1880. 4*d*.

The inventor employs the usual elements, carbon and zinc, separated by porous pot, and a solution of chloride of magnesium as described in his former specification, 3436, dated 26th August, 1879. For the negative solution he uses chromo-chloride of potassium, to which he adds water sufficient to produce a saturated solution.

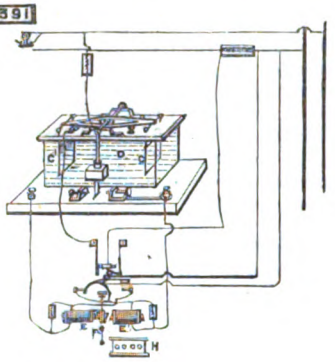
4350. Automatic Gas Lighting and Extinguishing Apparatus, *F. Wirth.—Dated 25th October*, 1880.—(*A communication from S. Dukas.*)—(*Not proceeded with.*) 2*d*.

A constant electric battery is employed for operating the apparatus, the battery being of sufficient power to heat to red heat a suitably placed platinum wire, the gas pipes serving as the conductors of the electric current to the said platinum wire, the return of the current being effected by the electro-magnet employed and the other pole of the battery. An anchor is held raised by means of suitable springs, and to the anchor is attached a pawl or catch pressed by a spring against a ratchet wheel, into the teeth of which the pawl gears, so as to turn the wheel one-eighth of a revolution each time the pawl is drawn down by the anchor, and the said wheel being attached to a four-way cock, this latter will be alternately opened and closed. A second cock is provided in an opening leading from the gas passage for allowing the gas to issue under the red-hot platinum wire at each downward motion of the anchor.

4391. Improvements in Means for Measuring the Amount of Electrical Current Flowing through a Circuit, *P. Jensen.—Dated 27th October*, 1880.—(*A communication from T. A. Edison.*) 6*d*.

The inventor uses balanced plates in a depositing cell, so arranged that the deposition of metal upon one plate overbalances it, and so operates the registering devices. A depositing cell is used (see figure), in which the plates are suspended, but insulated from a balanced arm, to which is attached a lever arm, D, on which is an adjustable weight. This cell is placed in a branch circuit. As the weight of one plate is increased by the deposit of, say copper, from the solution, it will tip the balanced arm whenever the weight of the increase becomes sufficient to overbalance the weight on the lever arm. The movement of the

4391

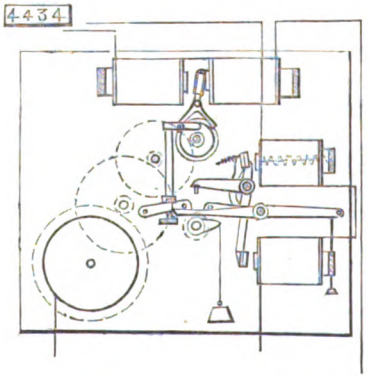


lever arm causes a movement of the registering apparatus. Suppose the parts to be in the position shown in the figure, and the current flowing through the cell, so that C is the anode and C^1 the cathode. As metal is deposited on C^1 it overbalances C, swings D out of perpendicular until it takes against the screw shown in figure, wherein circuit through E^1 is closed, E^1 attracts F, causing it to operate the register H. The inventor calls this apparatus the "vebermeter."

4434. Improvements in Telegraphic Recording Apparatus, *T. M. Foote.—Dated 30th October*, 1880. 6*d*.

This invention relates to apparatus for recording messages transmitted by electricity, and consists of various improvements for causing the letters, &c., to be automatically impressed in consecutive lines. A sheet of paper is fed forward beneath a type wheel and drawn back to its starting position by a roller actuated so as to bring the paper into proper position for commencement of another line. An electro-magnetic escapement turns the type wheel, to which movement is given by a weight or spring barrel through a train of clockwork, so as to present

4434

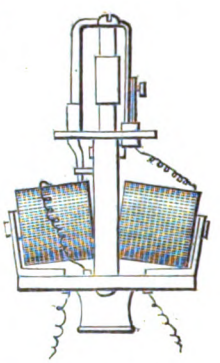


the desired letter for impression, after which a second electro-magnet acts upon the roller, and so brings the paper therein into contact with the type wheel, thereby producing the impression. After one line of letters has been printed the roller is returned by means of a third electro-magnet to its starting position; simultaneously with this the type wheel is liberated, and turns so that the zero point is presented at the place where the impression takes place, all the instruments in the circuit being then in unison. The figure is a side elevation partly in section of the apparatus in question.

4444. Improvements in Electric Gas-lighting Apparatus, *H. H. Lake.—Dated 30th October*, 1880.—(*A communication from W. Pelton.*) 6*d*.

The inventor opens and closes the gascock by electric action on a mechanical device, and employs, in combination with the burner, a stationary metallic arm, terminating in a platinum point near to the orifice of said burner; this electrode being fixed to, but insulated from the burner, and connected to one pole of a battery, and a movable electrode which is connected to the other pole of the battery and pivotted to the burner, so that when it vibrates it makes and breaks circuit, and so produces a spark which lights the gas. In the apparatus shown in the figure the inventor employs two electro-magnets and a vertically arranged vibrating armature connected with the gascock, and arranged between the magnets in combination with a movable and a

4444



fixed electrode, the latter being secured rigidly to and insulated from the body of the burner, and connected with a button joined by a wire to a battery, while the burner itself is connected with a magnet and a battery by a button, thereby making connection with the movable electrode, the whole being so arranged that the movement of the armature when attracted to one magnet, which is charged from the battery by pressure on its button, serves to open the gascock, and when attracted to the opposite magnet by depolarising the first and charging the second by pressure upon its button the cock is closed, while as long as the first magnet remains charged by the pressure upon its knob the movable electrode vibrates with rapid intermissions, and certain lighting of the gas is ensured.

4495. Improvements in Electric-lighting Apparatus, *W. R. Lake.—Dated 3rd November*, 1880.—*A communication from J. T. Nicholas.* 6*d*.

The inventor forms the base of the glass globe of his lamp, which is on the incandescent principle, or surrounds the conducting wires in the globe, with a cement, so as to avoid the tendency to the formation of cracks in the glass about the

4495

wires. The cement is composed of oxide of lead, silica, oxide of iron, oxide of copper, and potash or soda. The conducting wires are made of copper. The figure shows the cement tubes, which are fused and sealed to the wires at their upper ends and to the glass of the globe at their lower ends.

4581. Improvements in Telegraph Receiving Apparatus, *G. J. W. Fuller.—Dated 8th November*, 1880. 6*d*.

The invention is intended to obtain upon the instruments working long cables clearer definition of signals, to increase the rapidity of the signals, and so obtain a higher working speed. The bobbin on which the galvanised coils are wound is of peculiar shape—Fig. 1. The wire is wound on the bobbin in separate coils, that the outer coils may be shunted when not required. A semi-funnel-shaped tube or cup holds the mirror, and

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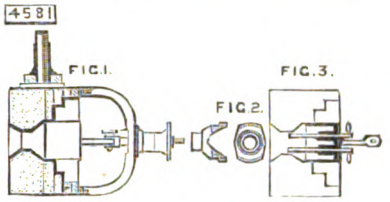
is fitted in from the front, while at the back as a sort of core is placed either (1) a special form of magnet, (2) a "Morse armature" shaped coil, (3) a bundle of iron wire, (4) a rod of iron, (5) a rod of iron surrounded by wires. Each of these can be connected with a battery or con-

4581

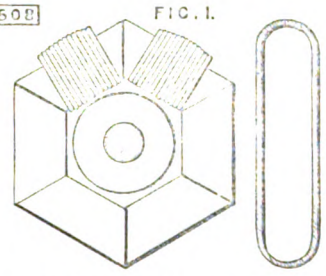


denser if required. Fig. 2 shows holder above mentioned; Fig. 3 a section of coils with one of the adjusting appliances. The inventor claims the special form of bobbin and the adjusting appliances.

4608. IMPROVEMENTS IN THE MEANS AND APPARATUS FOR GENERATING, SUBDIVIDING, AND TRANSMITTING ELECTRIC CURRENTS, ALSO IN ELECTRIC LAMPS, *C. F. Heinrichs.—Dated 9th November*, 1880. 1*s.* 2*d.*

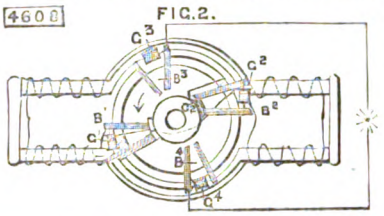
The first part of the title of this specification relates to improvements on previous patents, first, as regards the ring armature, one modification of which is shown in Fig. 1, and, secondly, in the method of dividing and transmitting the current shown in Fig. 2. A great many drawings are also given of improvements in Heinrich's well-known lamps, which we have not space to reproduce. Fig. 1 shows an armature constructed out of six electro-magnets arranged on the shaft. The inventor has proved by experiment that when the armature is rotated at a very high velocity (say over 10,000ft. circumferentially per minute)

4608 FIG. 1.



the iron core acquires little magnetism; he, therefore, modifies the above armature so as to reduce the mass of iron and expose a large length of insulated wire surrounding the core to the air, thus preventing the heating of the wire and maintaining the efficiency of the armature. In Fig. 2 two sections of insulated conducting wire are shown surrounding the ring core. Two ends of the wire are connected with each other, and the other two ends to the commutator plates C^1 and C^2, when the armature is rotated within the inducing magnets in the direction of the arrows. The current generated in the two sections is taken by the brushes B^1 and B^2, and passed under the brushes B^3 and B^4, and led to the coils of the inducing magnets to excite them. When the commutator plates have left the first set of brushes and passed under the second set, a break of the current which would take place is prevented by extra brushes, which are connected by two resistance coils G^1 and G^2, to the brushes B^1 and B^2, and when on continuing the motion of the armature the coils of wire leave the respective fields of the inducing magnets, an extra set of

4608 FIG.2.

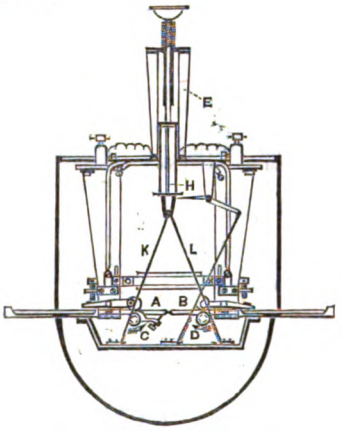


brushes (also connected with the brushes B^3 and B^4 by the two resistance coils G^3 and G^4) will prevent the production of sparks in the brushes B^3 and B^4. What has been described for these two sections of wire takes place in all the other sections.

4614. IMPROVEMENTS IN ELECTRIC LAMPS, *C. W. Siemens.—Dated 10th November*, 1880. 6*d.*

The object of this invention is to automatically adjust and regulate the distance between the carbons. The operation of the lamp is as follows:—As the distance between the carbons A and B increases by their consumption, the resistance to the direct circuit of the lamp increases, and consequently a larger amount of electricity passes through the by-pass circuit of the solenoid coil E. The core H is thus attracted upwards, and by its ascent draws up the two bars K and L. These, as they retire from their rests, come to bear with

4614



their ratchet teeth against the wheels C and D, and as they still ascend cause these wheels to turn partly round in the direction of the arrows, thus turning the grooved rollers shown in drawing, and causing the carbons to approach one another. Should the carbons be too near, so that the resistance in the direct circuit of the lamp is small, then the solenoid E having little power the core H descends, and when it has descended some distance moves a tappet lever, N, raising a bar, which acting on the wheel D, causes it to turn partly round in a direction opposite to the arrow, and so retract the carbon B.

4674. TELEGRAPH CABLES, *R. Kendal.—Dated 13th November*, 1880.—(*Not proceeded with.*) 2*d.*

In order to preserve cables from boring marine animals they are surrounded by a zinc sheathing, which, when immersed in the sea, rapidly becomes coated with a dense deposit that is very difficult to pierce.

4739. IMPROVEMENTS IN ELECTRIC BATTERIES, *H. E. Newton.—Dated 17th November*, 1880. —(*A communication from L. A. W. Desruelles.*) 4*d.*

The object of the invention is to prevent the liquid in batteries from spilling, and thus interfering with their portability. To this end the carbon and zinc plates are enclosed in a fibrous or spongy substance not affected by the acids of the battery, but which will, by capillary action, or molecular adherence, hold the exciting liquid in suspension. For this, asbestos and spun glass may be used.

4745. IMPROVEMENTS IN ELECTRIC LAMPS, *J. E. H. Gordon.—Dated 17th November*, 1880.—(*Not proceeded with*). 2*d.*

The object of the invention is to recover the metal dissipated in electric lamps, by causing a current of air to pass through the lamp, and afterwards through a flue in which a large surface of an inert material is exposed. The deposit is collected and reworked by ordinary refinery processes.

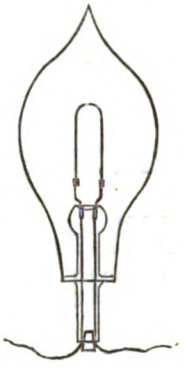
4825. IMPROVEMENTS IN DYNAMO-ELECTRIC MOTORS, *C. Kesseler—Dated 22nd November*, 1880.—*A communication from E. Kuhlo.—(Not proceeded with.)* 4*d.*

The object of this invention is to continuously cause the attraction of an electro-magnet to act on a conductor or transmitter of power without interrupting the current, and thereby preventing cessation of the power for a single moment.

239,149. INCANDESCING ELECTRIC LAMP, *Thomas A. Edison, Menlo Park, N.J.—Filed December 15th*, 1880.

Claim.—(1). In an incandescing electric lamp, the supporting neck formed with a concavity at the point where the leading wires pass through

239,149



and are sealed therein, substantially as set forth. (2). The supporting neck formed with a solid glass projection, to and upon which the enclosing globe is supported and sealed, substantially as set forth.

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Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manu-
facturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works,
IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited),
HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers,
MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia
Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER
WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

ELECTRIC LIGHTING.

THE

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION

(LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates, and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation is also prepared to receive applications for licences, or for concessions for defined districts, and to enter into negotiations with responsible parties for the sale of licences for the British Colonies. The superiority of the Brush system in economy and simplicity being thoroughly established, its rapid development is now assured.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

WHEATSTONE BRIDGE (second hand) WANTED; also a THOMPSON REFLECTOR, in first-rate condition, must be by a good maker.—Address, with full particulars and price, "A B C," care of STEEL and JONES, Advertising Agents, Spring-gardens, S.W.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

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JOHNSON'S TRANSMITTER

(PATENT).

LOUD AND CLEAR. NO JARRING.
PERMANENT ADJUSTMENT.
NO OXIDATION. ONE LOCAL CELL.

TASKER, SONS & CO.,
ELECTRIC AND TELEPHONIC ENGINEERS,
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HARBURG INDIA-RUBBER COMB COMPANY.
LONDON WAREHOUSE: F. WINTER.
138, LONDON WALL, WOOD ST., E.C.

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DUNCAN WALLET & CO.,

BONDED STORE AND PROVISION MERCHANTS,
15, BILLITER STREET, LONDON.

Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.
Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.
NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.
Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.
A Pamphlet, with full particulars, on application.
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THE "JAMIN" PATENT ELECTRIC LIGHT,
COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

NORTHERN FIRE and LIFE ASSURANCE COMPANY.
Established 1836.
Head offices—Aberdeen and London.

Subscribed Capital	£3,000,000
Of which paid up	300,000
Fire Reserve Funds	637,977
Life Funds, as per last account	£1,462,146

A. P. FLETCHER, General Manager.

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SLIP

West Indies.—The cable is interrupted between St. Thomas and St. Kitts.

Brazilian Submarine Company.—The traffic receipts of this company for the week ending 1st July amounted to £2,567.

Electric Light in Canada.—The Canadian Electric Lighting Company has received a contract for lighting the new Government offices at Quebec.

Vacancies for Female Telegraph Clerks.—By order of the Postmaster-General, a number of female clerkships will shortly be filled up by open competition.

The Anglo-American Cables.—We understand that the Telegraph Construction and Maintenance Company's vessel has successfully repaired the fault in 1,700 fathoms.

Electrical Railway at Berlin.—Pressure of other matter compels us to hold over until next week an illustrated article on Messrs. Siemens and Halske's electrical railway.

Algiers.—Telegraphic communication with Sfax and other places has been a good deal interrupted during the week; but, according to the latest accounts, is now restored.

The Eastern Telegraph Company.—This company's traffic receipts for the month of June, 1881, amounted to £40,074, and to £42,522 in the corresponding period of 1880.

Anglo-American Telegraph Company.—The traffic receipts of this company in June last amounted to £48,240, compared with £19,560 in the corresponding period of 1880.

Direct Spanish Telegraph Company.—The traffic receipts of this Company for the month of June last amounted to £1,456, against £1,277 in corresponding period of last year.

Eastern Extension Telegraph Company.—The traffic receipts of this Company for the month of June amounted to £29,339 against £29,100 for the corresponding period of 1880, or an increase of £239.

Direct United States Cable Company.—The estimated traffic receipts of this Company at 2s. per word for June, 1881, amounted to £16,080, against £6,520 at 1s. 6d. per word for the same period of 1880.

Cables still Interrupted.—The following telegraph cables are at present not working:—Pernambuco to Maranham, Orkneys to Shetlands, Antigua to Guadeloupe, St. Lucia to St. Vincent, St. Thomas to St. Kitts.

Great Northern Telegraph Company.—The receipts of this company in June were £21,760, making the total since Jan. 1, £113,840, compared with £108,035 in the corresponding period of 1880, and £96,180 in 1879.

Electric Light and Yacht Clubs.—These clubs are taking up the idea of lighting their rooms by electricity. We believe that the committee of the Royal Thames Yacht Club, has made arrangements for giving the light an immediate trial.

Western and Brazilian Telegraph Company.—The traffic receipts of this company for the week ended the 1st of July amounted to £1,780, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company.

Elecric Light in Mines.—The Royal Commissioners on Mines visited Wigan the other day for the purpose of carrying out further experiments with the electric light, with particular reference to its utility in mines as a means of avoiding explosions of gas.

Another Electrical Railway.—An electrical railway, similar to that now at work at Berlin, has lately been established in the Exhibition-square, at Frankfort, near the railway terminus. It is about 250 metres long, and has been laid down by Messrs. Siemens and Halske, of Berlin.

Anglo-American Company.—The Directors of the Anglo-American Telegraph Company have resolved, after placing £37,500 to the renewal fund, to declare an interim dividend for the quarter ending 30th June of 1 per cent. on the ordinary stock, and 2 per cent. on the preferred stock, both free of income tax, payable on the 2nd August.

Reassuring.—Among the items of intelligence forwarded to this country in the American language during the present week we noticed the following:—"Jay Gould, who is regarded by men who do not know him intimately as a mere speculator, is a pleasant, sympathetic man. He wept like a child when told the President was likely to die."

The Faure Battery.—Premises have been taken in London for the manufacture and sale of this battery, and we believe that it is intended shortly to have a number of batteries on view at rooms in the Strand, opposite Charing-cross Hotel. Anyone who chooses can then form his own opinion as to the merits of the battery, as it will be shown at work.

Prices.—The prices as quoted this week are:—For gutta-percha, per lb., genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d.; india rubber, fine Para, 3s. 6½d. to 3s. 6¾d.; negro-head, 2s. 3½d.; central American, 1s. 11d. to 2s. 5d.; Assam and Pegu, 1s. 3d. to 2s. 1d.; other East Indian, 1s. 9d. to 2s. 4d.; Madagascar and Mozambique, 1s. 6d. to 2s. 4d.

Cuba Submarine Telegraph Company.—The number of messages passing over the lines of this Company during the month of June last was 2,757, estimated to produce £2,700, against 2,654 messages, producing £3,147, in the corresponding month of last year. The traffic receipts for the month of April last, estimated at £3,100, realised £3,193.

The Faure Battery and Electric Lamps.—At a private party, the other evening, at the residence of Mr. W. Spottiswoode, F.R.S., the conservatory and other portions of the house were illuminated by Swan and Maxim lamps, the necessary current for which was derived from several of the Faure secondary batteries which have recently been brought over from Paris.

The Electrical Railway at Milan.—This railway, the the construction of which we noticed recently, is about 400 metres long. The generator is placed in the machinery section of the Industrial Exhibition, from thence the current traverses copper-conducting wires until it reaches the rails. There are three small cars, or carriages, covered with a canopy of different coloured canvas.

The Paris Electrical Congress.—A decree appointing sixty-five French members of the Congress has been signed, and will shortly be published. No reporters or members of the outside public will be admitted to the congress, an official report of which will be published by the general committee. The jury will not be appointed by exhibitors, who will thus have no influence on the awards.

Electric Light in the House of Commons.—We understand that the lamps used in the late experiments in the House of Commons are to be removed, in spite of the intimation of Mr. Shaw-Lefevre that further experi-

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ments were to be undertaken during the recess. It would appear that the opinion of the hon. members of the House was not favourable enough towards the new light to encourage further experiments.

TELEGRAPHS IN QUEENSLAND.—"Pugh's Almanac" for 1881 says:—"The telegraph system is another remarkable instance of the rapid progress of the colony. The total length of telegraph lines open on 1st April, 1880, may be computed at 5,803¼ miles, besides which the lines proposed to be constructed amount to 820 miles." The revenue for the nine months ended 30th September, 1880, derived from the telegraph amounted to £26,751.

ELECTRIC LIGHT AT EASTBOURNE.—The electric light is fast coming into favour as one of the attractions that should be possessed by seaside resorts. Eastbourne takes the lead in this particular. The large pleasure grounds known as the Devonshire Park, and including the Floral Hall, are to be illuminated on the 11th inst. Messrs. Siemens have the work in hand. There are to be seventeen lamps altogether, three in the Floral Hall and fourteen in the grounds.

ELECTRIC LIGHT IN EDINBURGH.—It is now definitely settled that Princes'-street, North Bridge to Tron Church, and Waverley Bridge shall be lighted by the Brush electric light for three months as an experiment; also that during Her Majesty's stay at Holyrood in August the front of the Palace shall be similarly illuminated. The cost of the apparatus during the three months is estimated at £389 10s. The wires will be carried overhead on the present gas lamps.

INTERNATIONAL ELECTRICAL EXHIBITION.—In addition to the appointment of the Earl of Crawford and Balcarres as Chief Commissioner at the Exhibition, the following have been appointed Commissioners:—Sir Charles T. Bright, Professor D. E. Hughes, F.R.S.; and Lieut.-Colonel C.E. Webber, R.E. The Palais de l'Industrie in the Champs Elysées, where the Exhibition will be held, was on Friday last officially handed over to the Exhibition Committee, and the preparations will now be pushed on.

ELECTRIC LIGHT IN NEW YORK.—A telegram, dated Friday last, says that the Brush Electric Light Company is erecting at its own expense a pole 150 feet high in Union and Madison-squares, of New York, each to have on the top six lights of 6,000 candle-power each, as an experiment in lighting the city from above. Three similar poles are to be put up in the lower part of Central Park. The result of this experiment will be interesting when compared with the high lights of Messrs. Siemens in our own city.

ELECTRIC LIGHT IN LIBRARIES.—A writer in a provincial contemporary testifies to the utility of the electric light in libraries, not only on account of the non-heating of the atmosphere, but owing to its having no bad effects on the covers of the books. Anyone who has had much to do with libraries will have noticed how brittle and rotten the bindings of books become on those shelves which are near the ceiling of the room, and, therefore, exposed to the heat of the gas. This is not likely to arise when the electric light is used.

TIME BALL AT KANSAS, U.S.A.—A time ball has recently been erected at Kansas city as a part of the time service of the Morrison Observatory. It is the first attempt in this direction in the West. The apparatus by which the ball is dropped was constructed under the direction of Mr. W. F. Gardner, the instrument maker at the Naval Observatory at Washington. The entire cost of ball and machinery was about 120 dollars. Kansas is about 100 miles from the Observatory, and the ball is dropped within one or two tenths of a second of correct time.

APPARATUS FOR THE EXHIBITION.—It is stated that there will be shown at the approaching exhibition a model of a new signalling apparatus, the invention of a railway official at Elberfeld, which is intended to dispense with intermediate block stations, and to allow trains to follow each other at closer distances than hitherto. The device, which has been tried and found to work excellently, is called an electro-automatic block station telegraph, and is so constructed as to register simultaneously by wheel pressure at two stations the passage of a train at a point equidistant from them.

TELEGRAPH POLES.—In reply to the question of Mr. Pugh, M.P., as to whether the Post Office Department used foreign timber for poles, whereas many railways used home-grown wood, and whether the Postmaster-General would cause an inquiry to be made as to the relative prices of the two, Mr. Fawcett said that the telegraph posts used by the Post Office were of foreign timber, and foreign timber was used by all the leading railway companies for similar purposes. The reason was that foreign timber possessed greater durability owing to the ease with which it took the creosote process.

ELECTRICITY AND STEERING GEAR.—The correspondent of a Sheffield paper is answerable for the following:—A ship has just arrived in the Thames from Glasgow the exponent of a new experiment with electricity. Its steering gear has been fitted up with electricity, and at the slightest touch of the fingers the vessel can be guided through the roughest seas. The apparatus answered admirably, with one not unimportant exception. The electric battery played a merry game all through the voyage with the compasses, which were practically useless. This, of course, disposes of the experiment.

NEW TELEPHONE COMPANY.—The formation of the European Telephone and Electrical Manufacturing Company (Limited) is announced. The capital is £800,000, in 450,000 Preference Shares of £1 each, and 350,000 Deferred Shares of £1 each, the former being entitled to a cumulative preferential dividend of 8 per cent. The company is formed to unite the Edison and Gower-Bell interests in supplying telephones to a great part of the Continent, as well as in establishing telephone exchanges where it is found undesirable to deal with existing companies. It will also manufacture every description of telephonic and electrical apparatus.

A LARGE ELECTRO-MAGNET.—*Les Mondes* of the 23rd of last month contains a description of a large electro-magnet that has been made by Herren von Feilitzsch and Holtz for the Greifswald University. The case is made of twenty-eight iron plates of horseshoe shape, bound together by iron rings, so that they form a cylinder of 195mm. diameter. It is 125ctm. high, and weighs 628 kilogrammes. The magnetising helix consists of insulated copper plates and wires, weighing together 275 kilogrammes. The plane of polarisation is rotated in flint glass. This magnet, with fifty small Grove cells, will fuse 40 grammes of Wood's metal in the Foucault experiment in two minutes.

INTERNATIONAL MEDICAL AND SANITARY EXHIBITION.—At this exhibition, which is to be held at South Kensington, in the Albert Hall, and a portion of the Royal Horticultural Society's premises, from the 15th of July to the 13th of August, the judges of the electrical instruments and appliances exhibited will be:—Messrs. E. C. Chepmell, M.D.; A. O. M'Kellar, F.R.C.S.; J. C. Steele, M.D.; Professor J. Marshall, F.R.S.; and Mrs. Wardroper. The exhibition has been organised by the committee of the Parkes Museum of Hygiene. The exhibits will be examined

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by the judges on Friday, the 15th inst., and the exhibition will be formally opened on the following day.

EASTERN TELEGRAPH COMPANY.—The eighteenth ordinary general meeting of this Company will be held on the 14th inst., at the Cannon-street Hotel, to receive the report of the directors for the six months ended the 31st March, 1881. The Company's revenue for this period amounted to £302,158, which, after deducting ordinary and other expenses, and adding the sum of £28,430 brought forward from the preceding half year, leaves a balance of £229,616. The sum of £70,000 has been placed to the reserve fund, and the total amount of reserves now stands at £392,060. An interim dividend of $1\frac{1}{4}$ per cent. has been paid on ordinary shares, and a final dividend is recommended for the year ended 31st March of 2s. 6d., and a bonus of 1s. per share, payable on the 15th inst., making with the previous payments on account a total dividend for the year of $5\frac{1}{2}$ per cent. on the ordinary shares.

LETTER SORTERS AND TELEGRAPHISTS.—A statement has been forwarded to Mr. Fawcett and the members of the House of Commons by the letter sorters of the Eastern Central District Office, in which they contradict the assertions made by the central committee of the provincial telegraph clerks. They state that the clause in the circular recently issued by the latter, stating that "£130 per annum is the highest salary attainable, and is the same scale of salary as is now given to sorters of letters in the Post Office, whose work, it need not be pointed out, requires far less education, intelligence, and skill, &c.," is not correct, as the above-mentioned scale of salaries is not yet extended to the London sorters, whose claims are still under consideration. They also strongly protest against the second half of the clause, referring to their work requiring far less education. They state that it has been the practice for some time past for the leaders of the telegraph clerks' agitation to speak of them—the sorters—in a derogatory manner. This they have hitherto overlooked, but they now think it time to emphatically record their protest against the unfairness of these assertions.

NEW CABLE FOR SHETLAND.—With reference to our recent note in which we stated that the Postmaster-General had been petitioned to repair the broken cable at the Shetland Islands, we learn that a communication was received in Lerwick from Mr. Laing, M.P. to the effect that Mr. Fawcett did not see his way to give a direct cable from the mainland to Scotland, but it had been decided by the Post Office that a new cable should be laid from Orkney to Shetland, a new route being chosen to avoid the dangerous tideways. Mr. Fawcett maintained that a direct cable from Fraserburgh would cost £26,000, whilst a new cable from Orkney to Shetland could be laid for £11,000, the sum the Post Office proposed to expend. The Treasury had sanctioned the expenditure of £26,000, of which 11,000 was to be devoted to this new cable, and the other £15,000 to getting a cable ship, to be kept ready for repairing not only the Shetland cable, but also those in the Pentland Firth and at the Stornoway. This Mr. Fawcett thought would be better than spending all the money in a direct cable. The Shetlanders, however, do not agree with him, and think it is but scant justice to their claims, and also unfair that, to enable the Post Office to provide the means to a get cable steamer for their general purposes, the inhabitants of Shetland should be put off with an insufficient service.

THE TELEGRAPH CLERKS AND THE GOVERNMENT.—The provincial telegraph clerks have addressed an appeal to the members of the House of Commons, pointing out that the scheme of revision issued by the Postmaster-General is far from favourable to their interests, and they "unanimously and unhesitatingly condemn it;" because, although their claim to be considered permanent clerks in the Civil Service of the Crown is undisputed, they are still denied that scale of salary, rising from £80 per annum to £200 per annum, which the Playfair Commission recommended; because £130 per annum, or £16 per annum above the present maximum, is the highest salary attainable, and the same scale of salary is now given to sorters of letters in the Post Office, whose work requires far less education, intelligence, and skill; because a system of classification is retained, which will effectually prevent the great majority of the staff from ever obtaining a salary higher than 38s. per week, at which sum, in the course of two years, the wages of a number of men who are now receiving 35s. per week will again become stationary; because seventeen years must elapse before a clerk entering the service at 12s. per week can obtain a salary of 38s. per week, beyond which he can never expect to rise; because Sunday duty, of eight hours in four weeks, is still demanded without remuneration; because the payment for overtime is calculated at the rate of seven days, or fifty hours per week, instead of six days, or forty-eight hours per week.

TAMPERING WITH TELEGRAMS.—The *St. James's Gazette* says:—A recent experience of our own suggests that telegrams may be tampered with in a very serious way. On the evening before the Derby Day our correspondent at Epsom telegraphed from that town as follows:—The weather is very fine at Epsom to-day, but the ground is very hard and likely to prove fatal to the chances of two or three of the competitors. Mr. Gretton's Geologist arrived this morning from his training at Fyfield and is looking remarkably well. The company is not so large as usual, and the racing so far as it has gone is very uninteresting.—That was the whole of the telegram, as handed in at the telegraph office. But when it reached our office it contained the expression of an opinion that Geologist "should win!" Now we know that our correspondent's judgment is trustworthy in such matters, but that Geologist "should win" seemed so unlikely that this particular expression of opinion was moderated. It never occurred to us that the message might have been altered in transmission, or that our readers were under obligations to some telegraph clerk for the interpolation of this precious "tip." So it was, however. There is no pretence of excuse on the part of the Post Office authorities, to whom complaint has been made. Their answer is an expression of regret for "the error," and an assurance that "very serious notice will be taken of the irregularity." We suppose we shall not go too far if we point out that errors and irregularities of this sort are of a very suspicious character. Their inconvenience is obvious.

THUNDERSTORM AT THE CAPE.—The following interesting account of a thunderstorm was communicated to a recent number of *Nature*, by a member of the Cape Mounted Rifles. He said:—"The storm set in about 6:0 p.m., whilst the men were at stables, and was accompanied by loud thunder and vivid flashes of lightning. At 6:15 there was a fearful roll of thunder, accompanied by a most vivid flash, which lit up the square for at least thirty seconds. It struck the barracks at the upper end, ran past a room to the stables, which have iron roofs; it ran along the course of the roofs into the stables, striking down two men in the doorway. It then ran along the iron of the manger, flooring all the horses, nineteen in all, and so went to ground. One man was struck in

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the left shoulder bone, the fluid passing from there under the left arm to his watch in the left-hand trousers pocket, and burnt a hole clean through the silver case. From the watch it struck again six inches below, and travelled round the leg under the knee, and from thence probably to the spurs, as no burn was found below the knee. The extremities of both tracks were marked by large burns, and each track by a burn two inches over. The surgeon says it was the most miraculous escape he ever saw, the watch having saved the man's life. The second man was merely stunned, and lost the use of his legs for some hours; he was standing in the stable behind the first, and although only slightly burnt, is still unable to walk. The other is doing well, but is rather dazed. Ten other men were floored, but soon regained their legs. One of the horses was struck in the head and killed; two others, blind in both eyes, were shot yesterday; and four more blind in one eye are condemned. A horse in town was struck, and his fore-leg broken in four places. Within a hundred yards of the barracks is a powder magazine full of powder, fitted with conductors which were struck several times. This occasioned great alarm to the inhabitants, as it contains many tons of powder."

Storage of Electricity.—In our issue of June 18, on page 18, we referred to a letter of Major Seaver to *The Times*. We give herewith the letter and the preliminary comment as it appeared in our daily contemporary:—

"The following letter refers to our recent remarks on a new company called 'La Force et la Lumière.' The explanation, while it proves the necessity for our remarks, appears to be fully satisfactory as far as the writer of the letter and Sir William Thomson are concerned:—'Paris, June 14. Sir: As a director of the 'Société la Force et la Lumière' you have rendered me a great service by your remarks in the City article of *The Times* of yesterday. Permit me to thank you for it and to point out that the shares now being offered to the public are not, properly speaking, an issue by the company, but simply a sale by a private individual, who received them in part payment for the transfer of patent and other rights to the company. You are quite right and justified in explaining that Sir William Thomson is not in any way identified with the financial operations of the company, and I trust you will allow me also to explain my connection with it, which to a great extent is morally the same. I think I am entitled to this, as my letter, printed in *The Times* on the 19th of May last (under my initials and before I was connected with the company) was the first explicit public announcement of the great things to be expected by storing electric energy. Like Sir William Thomson—but in an infinitesimal degree comparatively—I am a man of science and not a financier, and my attention having been drawn to the novelty of M. Faure's discovery, I went into the matter *con amore*, with the intention of bringing it before Sir William, and thus perfecting and giving to the world in a practical form a discovery of the importance of which you have formed no meagre or erroneous estimate in your leading article of the 9th inst. It was to guard Sir William Thomson, as a friend and colleague, against any undue use of his name or position as consulting engineer to the company that I consented to accept a seat on the board, and on the express condition that no prospectus or publication of any sort bearing his name should be issued without his previous approval and consent. Unfortunately, I was absent from Paris for over three weeks, and it was only at Vienna, when too late to stop the issue, I learnt that the prospectus you refer to had been put into circulation. I could only telegraph the fact to Sir W. Thomson, offering to withdraw from the company in case he disapproved the contents of the circular. I never saw it until my arrival here a few days ago, and Sir William can testify, if necessary, how annoyed and dissatisfied I was at the proceeding. I have only to add and repeat that the prospectus you refer to is not an issue by the company, but a sale of shares for private account; and while I am quite convinced of their value and the great future open to us in the electrical world, I wish it to be distinctly understood from me, as the only Englishman on the Board, that the operations of the parent company 'La Force et la Lumière' in England are to be confined to the transfer of their patent and other rights to an exclusively English company with a board of directors of the highest standing in the electric and financial circles of London, and that the entire control of its future operations will rest in the hands of gentlemen whose names will be a guarantee against a shadow of suspicion.—Yours, &c., 'F. J. Ricarde-Seaver.'"

Thunderstorms.—A very heavy thunderstorm broke over London and district on Tuesday night, accompanied by the most beautifully vivid lightning that has been seen for some time. The storm began about 12 p.m., and kept returning on and off until daybreak. From the provinces reports of severe thunderstorms are numerous, and they would appear to have extended all over the United Kingdom. During the storm in Dublin a woman working in a field near the city was struck by lightning and killed. Two others were also seriously injured. At Blackburn, in Lancashire, there were deafening peals of thunder and vivid flashes of lightning. The storm commenced about half-past 8; rain fell in torrents, and for some hours raged with great fury, the whole town being illuminated. A storm of hail, rain, thunder and lightning broke over Oswestry soon after 8 o'clock, and continued for nearly an hour. The lightning, which was both sheet and forked, was extremely vivid, and the rain fell in torrents. A youth, named John Bland, employed as driver at the Binchester Colliery, Bishop Auckland, whilst leaving his work, about six o'clock, was struck by lightning and killed on the spot. Shortly after five a storm passed over Swansea, being particularly heavy at the village of Blackpill, between Swansea and the Mumbles. The lightning struck a cottage adjoining some nursery grounds. The chimney and a part of the roof were torn away, the *débris* and broken tiles passing through the glass roof of one of the large greenhouses. Liverpool and neighbourhood were visited by heavy thunderstorms, accompanied by vivid flashes of lightning and a great fall of rain. The atmosphere, before and after the storm, was exceedingly close. At Darlington total darkness prevailed from half-past five till six o'clock. The Isle of Man was also visited by a thunderstorm, which is said to have caused considerable damage. The lightning was intensely vivid. Telegraph wires were much injured, and communications were interrupted. At Bradford the belfry of Christ Church was destroyed. At Bury, in Lancashire, a building known as Top Wood Mill was struck, and fell bodily into a reservoir adjoining. At Durham houses were injured, and at Houghton-le-Spring some cows were killed. During the height of the storm at Liverpool, the Pavilion of the Wavertree Cricket Club was struck, and a portion destroyed. The lightning attacked the flagpole and shivered it into splinters, it then passed through a tent, one side of which it completely ripped up. At Ormskirk a boy was killed, many buildings were struck, and horses and cattle killed. In Flintshire, at a village called Givespyr, the lightning entered a house in which a man, his wife, and four children were seated. One child was killed on the spot, and another child and the father severely injured. Near Tarporley the spire of Tilstone Church was struck, the lightning passing through the roof. At Bangor, in Wales, a schooner lying in the port had her mast split in two, and the man at the wheel of the steamer "Menai," which plies to Beaumaris, has lost the use of his hand through a lightning flash. Several buildings were struck in Anglesea.

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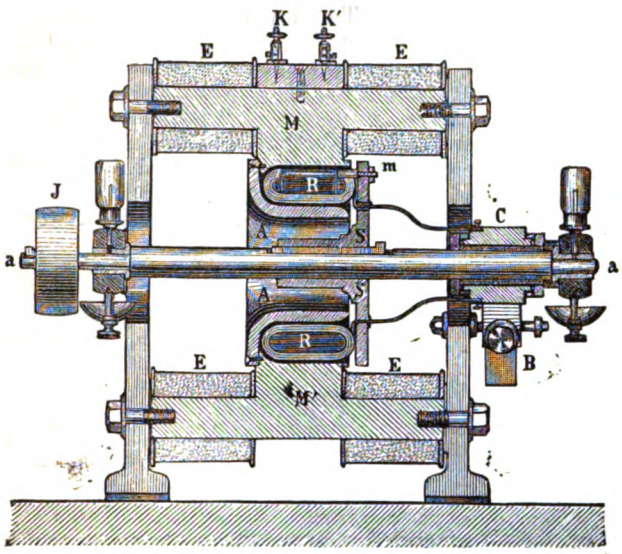
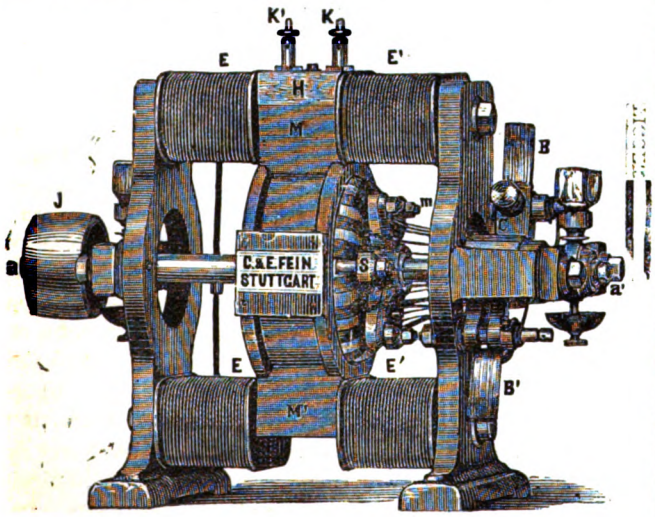
FEIN'S DYNAMO ELECTRIC MACHINE.

Last year Mr. W. E. Fein patented in Germany the machine we illustrate below. We are indebted to the inventor for the description we are now able to give. Dynamo-electric machines constructed upon the Pacinotti-Gramme principle have this disadvantage, that the inducing force of the poles of the electro-magnets acts only upon the external windings of the wire of the armature, the other parts being far less affected by the inductive action, thus increasing the resistance of the circuit, and conducing to the heating of the ring.



To avoid these drawbacks flat rings instead of cylindrical ones have been used, so that the exciting force can act on both sides of the ring, but the windings of such a ring diverging radially necessitate a much greater diameter in order to use a certain length of wire, and this enlargement of the circumference, increasing as it does the resistance to rotation, requires a greater expenditure of motive power for a flat than for a cylindrical ring.



Considering these circumstances, Mr. Fein designed the following construction, by which he claims to preserve the cylindrical ring, and to obtain the advantage it gives without the disadvantages. He says:—"By fixing it in a particular manner to the axle, and by giving the armature a suitable shape I arranged for the exposure of nearly the whole length of the coils to the effects of the magnets.

"Fig. I. shows the cross section, Fig. II. a side view of this new dynamo-electrical machine. The cylindrical ring R R, furnished with the coils, is screwed on to the brass star S S, which by means of a socket is keyed to the axle A A', put in motion by the pulley J. The ends of the single coils pass partly through insulated apertures in the spokes of the star, partly through the intervals between the same to the commutator C, which, in order to be easily accessible, is placed on the axle lengthened for this purpose outside the framing.

"By means of the two brushes B B, sliding on the commutator, the currents are collected in the usual manner.

"To avoid the Foucauld-currents and the production of heat resulting therefrom, the ring itself is composed of a large number of insulated iron-foils. The cores of the electro-magnets are furnished with the armatures MM', which are placed in front of the external circumference of the ring; in connection with these are the half-funnel shaped pole pieces A A, which surround the ring on two more sides, so that nearly the whole length of the wire moves in the magnetic field, leaving only those few parts of the wire which are opposite the brass star unaffected by the inducing force. The increased useful effect of this machine may be shown in a simple and surprising manner by taking off the pole pieces AA, the induction thus affecting only the windings on the outer circumference of the ring, as is the case with the Gramme machines; only half of the force of current is obtained which the machine furnishes when under the influence of the armatures AA. The advantages of my construction may be summed up in the following points:—

"1. The windings of the coils of the ring are exposed nearly to the whole of their length to the influence of the magnets, diminishing thus the resistance of those parts which have no electromotive force.

"2. The composition of the ring is such as to restrict as much as possible the generation of Foucauld currents; therefore, the loss of motive power by the production of heat is rendered insignificant, and the excessive heating of the ring prevented.

"3. The ring being of a proportionally smaller diameter the velocity of its rotation may be increased, and the machine requires less motive power in proportion to its efficaciousness."

MR. HERRING'S UNIVERSAL ALPHABET.

The following is a copy of a portion of a letter addressed by Mr. Herring to the Right Hon. Sir Stafford Northcote on the subject of the adoption of his instrument by the Post Office:—

"I will not suppose that it was intentional on the part of Sir Richard Cross, but the tactics adopted have been also disastrous to the petition itself, as the fact of my having petitioned the Sovereign by the advice and with the approval of the Secretary of State deprives me of the privilege of bringing it before the House of Commons. This Sir Richard Cross distinctly wrote to Mr. Goschen, who would otherwise have moved in the matter. Thus a conspicuous case, bristling with every form of deception and injustice, fully detailed in the petition has been allowed and assisted by the Conservative party to pass unheeded, the present Postmaster-General,

RICHARD HERRING

CANONBURY

Mr. Fawcett, being content to write to me that 'he does not feel called upon to enter into the past history of the case.' Thus, also, all my money and time expended at the suggestion of the telegraph authorities have been wasted, all their agreements with me being unfulfilled, the eminent scientific men engaged and paid by me to act as referees at the request of the Post Office not being even invited to meet, and the telegraph service, as many competent persons believe, has been deprived of a much more simple, speedy, and accurate system than the one in use. Eminent electricians affirm that had my system been adopted it would have rendered the Post Office independent of the serious risks of the present crisis.

"No doubt you are acquainted with the present system of telegraphing, and, therefore, I need only explain what I

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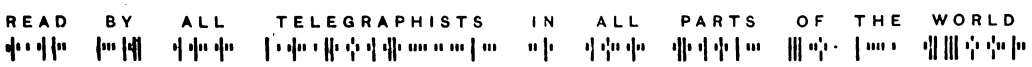
deem to be an improvement on it, which you will readily glean from the enclosed circular. The telegraph signs are presented to the reader by my invention in a vertical and definite form, and thus it is now possible to cast the letters of the telegraph alphabet in suitable type for the production of a handy primer for use in



board schools as a reading book. The advantage of this suggestion in familiarising the youth of both sexes with what is, in fact, the only language that is in use all over the world will, probably, commend itself to you as one of the best means of getting rid of such skilled manipulation as the department has now to pay for so highly. Boys and girls of fourteen years of age are found quite capable of being entrusted with a watch, and the telegraph instrument I propose for use would require no greater care.

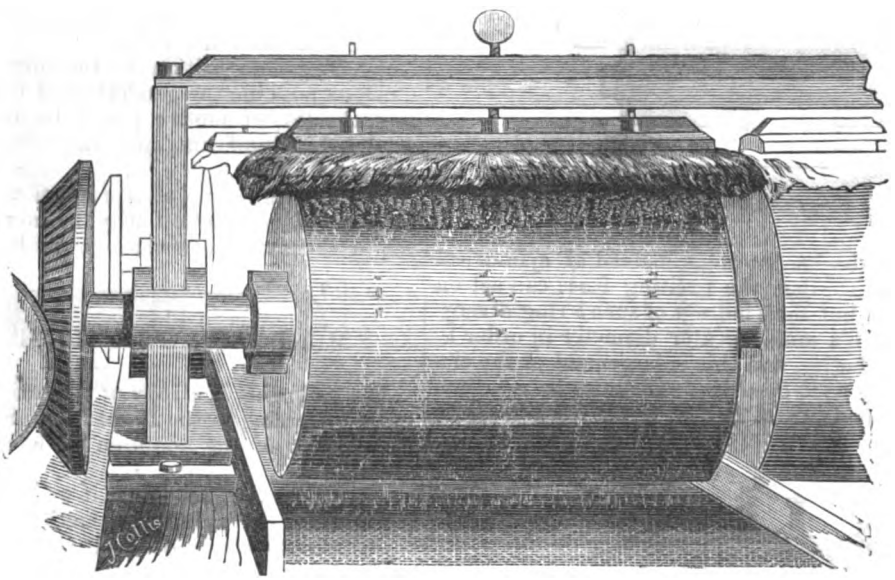
"From all that I have written, it must be apparent to you that if the successors of the party which you lead will not, or, in fact, *cannot* remedy the injustice of which I have so much reason to complain, I must look to you to do so, and that favour I now respectfully solicit at your hands.—Yours, &c.,

"RICHARD HERRING.

"Rt. Hon. Sir Stafford Northcote, M.P."

We give herewith illustrations of the alphabet which Mr. Herring proposes to introduce, so that our readers can judge of its practicability and usefulness for themselves.

ELECTRICITY AND MILLING.



At the recent Milling Exhibition held at the Agricultural Hall, Islington, we noticed a machine exhibited which depended for its utility upon frictional electricity. This machine is called the "Electric Middlings Purifier," and was exhibited by Mr. J. W. Throop, the agent in this country of Messrs. Smith and Osborne, of the United States. It was first exhibited at the Cincinnati Exhibition held last year, and was mentioned by various publications at the time. The apparatus was, however, unknown practically in England till this year. The machine consists of a frame carrying a sieve at the top, with a conveyer underneath to take away the purified middlings. At a distance of 1in. or 2in. above the cloth sieve are placed hard vulcanised rubber cylinders, 6in. diameter, $\frac{1}{4}$in. thick, and 9in. long. One such cylinder is shown in the illustration.

Three cylinders revolve upon one shaft, and these series of three are placed 14 inches apart. A sheepskin cushion presses upon the top of the cylinder and the friction of the cylinder during its rotation against the sheepskin generates the electricity. The cylinders revolve about thirty times per minute, and being electrified attract the bran and light impurities from the middlings underneath. The bran and impurities are carried round by the revolving cylinder to the sheepskin, when they are brushed off into tin troughs placed to receive them near each series of rolls, and carried by endless straps with sweeps attached to the side of the machine, collected and discharged through one spout. The motion of the sieve, about 400 per minute, causes the bran and light impurities to rise to the top, while the pure middlings pass through the cloths. It will be seen that the pressure of the sheepskin can be adjusted by means of screws. We trust that electricity will be found useful in other industrial processes, and that its introduction into milling work is an indication that new fields of work will be found for it.

THE ACTION OF SOLENOIDS IN ELECTRIC LAMPS.*

BY FR. KRIZIK.

It is well known that if an iron bar be placed near a wire coil, through which a current is flowing, in the direction of its axis, the bar is attracted towards the coil until the centre of the coil is on a level with the centre of the bar. It is also well known that the force with which this bar is attracted towards the coil reaches its maximum when the one end of the bar is on a level with the centre of the coil, and when that end of the bar constantly sinks the nearer the two centres approach one another, until, when the two centres are on the same level, it becomes suddenly *nil*. In other words, it is well known that the exertion of the force of solenoids upon a cylin-

* Translated from "Zeitschrift für Angewandte Elektricitätslehre," Band 3, No. 1, 1881.

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drical solid or hollow iron bar varies also with every variation of the position of this bar with regard to the solenoids.

In the following cases special iron bars will be given, on which, contrary to former cases, the expressions of force of one or several solenoids remain the same, almost to half the length of the bar. This new action was obtained by giving to the bar several cross cuts, according to the variation of attraction at the different points, or by combining in one long bar several separate long bars, or several bars at a considerable distance from one another.

Figs. 1—5 represent different forms of these bars. Their application may be manifold, and especially in connection with a solenoid when a proportionate motion or attraction is to be attained on a greater length than hitherto, or in connection with a solenoid and another opposing force (as that of elasticity, weight, or water), or in connection with two or several separate solenoids belonging to one another, whose expressions of force are also in opposition where it is a question of keeping this bar in a definite position, or of a displacement of it corresponding with the variation of the expression of force, as, for instance, in the case of electric lamps.

Fig. 6 shows the application of such a bar in connection with a solenoid to electric lamps. A is the bar, S a solenoid inserted with the light ray in the same circuit, B and B_1 the two carbons, of which one, B_1, is fixed, the other, B, fastened to the bar A, c and c_1 friction rollers, which serve to direct and bring about the contact with the bar A, which is made in a brass tube. The solenoid S attracts the bar A upwards, when the circuit in the two carbons is closed by the pressure of the bar. In this case, with a definite light ray, the magnetic exertion of force maintains an equal weight to that of the bar, which may also be diminished by a counterpoise.

This arrangement can be applied to horizontal as well as to hanging or standard lamps. In the case of horizontal lamps the weight of the bar, which lies horizontally upon rollers, is eliminated by a weight corresponding with the flame. The length of the carbons consumed in this lamp depends on the length of the bar, which within certain limits may be chosen at will. Thus bars of one metre in length have been already applied to electric lamps, in which carbons were burned of almost half a metre in length. The length of the carbons (*i.e.*, the duration of burning of a lamp) depends also upon whether only one or both carbons are moved towards one another by the said iron bar, which arrangement may be met with both in this kind of lamp and in the following ones.

Fig. 7 shows the application of a bar in connection with a solenoid inserted in a branch of the main current. A is again the independent iron-bar, S a solenoid of powerful resistance inserted in a branch of the main current, c, c_1 friction rollers, serving both to effect the contact, and also to suspend the bar and the weight Q. The weight Q must be made equal to the weight of the bar together with the carbon and brass tube plus the attraction of the solenoid, with the desired flame. The main current passes from + pole to rollers c and c_1, bar A, carbon B, light ray, carbon B_1, to — pole; the *side* current from + pole through the solenoid S to — pole. This lamp also may be adapted as a hanging, standard, or horizontal lamp; only the magnitude and the nature of the application of the weight vary in different cases, which weight may be in all cases replaced by other forces, such as elasticity, or even by a float. In this lamp, as well as in others possessing a solenoid, half the bar may also be employed.

A further modification of this lamp would be to unite a hanging-lamp and a standard lamp in one, and to let both carbons move towards one another by the shunt circuit. Both solenoids can be inserted in one or in two branches of the main current, which passes only through the two carbons. By this arrangement a double duration of burning is obtained.

Fig. 8 represents the application of the proportionate action of two solenoids on an independent iron bar in electric lamps. A is the iron bar suspended on roller r, and entirely or partially balanced by a weight, Q; S the solenoid in the main current, S_1 the solenoid of powerful resistance in the side circuit, c and c_1 friction rollers. If both solenoids with a definite length of flame possess the same magnetic momentum they keep the bar in a definite position, and move with it forthwith in one or the other direction, if, from any cause, the magnetic momentum of either bobbin varies. The fixing of the solenoids must take place in such a manner that the distance of the centres one from the other be equal to half the length of the bar. In horizontal lamps, since the bar lies horizontally on rollers, the weight Q may be altogether dispensed with.

Instead of two solenoids, three may be applied in such a way that the solenoid S is retained, while S is proportionately strengthened, and a third attached, inserted also in the side circuit, through which, however, the side current must circulate in a direction contrary to that of the main current. This third solenoid has for its object (whilst the current in the side circuit is strengthened) to weaken the development of force of the main current upon the bar A, and thereby to regulate the flame more accurately. If the weight Q be replaced by the weight of the lower carbon-holder, which must be made proportionately large, we have a lamp in which both carbons move by one bar. If we choose for the suspension of the bar A double rollers of different diameters corresponding with the consumption of the carbons at the different electrodes, we then obtain a lamp in which the flame remains always at one point, so that such a lamp may be used also as a focus lamp.

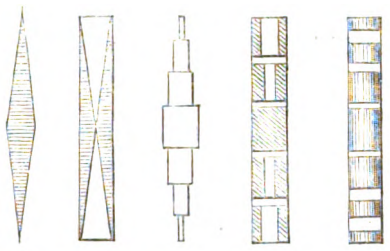
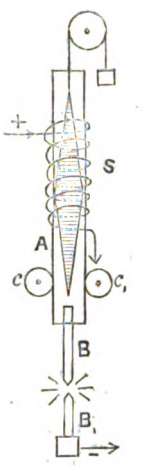


FIG. 1. FIG. 2. FIG. 3. FIG. 4 FIG. 5.



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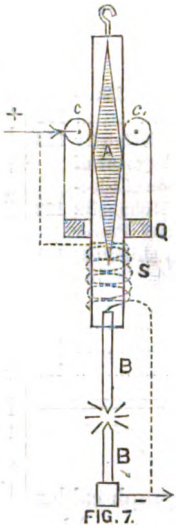

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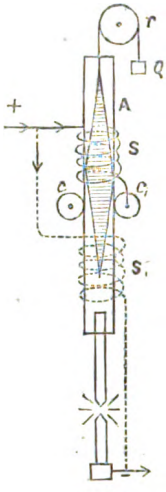

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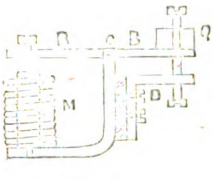

FIG. 9

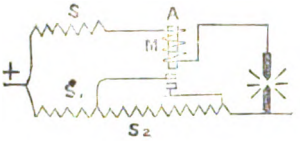

FIG. 10.

Fig. 9 shows an automatic switch of a portion of the coils of the side circuit when the flame is increased, or when the main current is interrupted. M is an electro-magnet inserted in the main current, B its anchor revolving around the point c, which is kept apart from the electro-magnet M by a counterpoise Q, or by a coil. D is an insulated bracket which is provided with a clamp and a contact-screw.

Fig. 10 represents the insertion of this switch. Its operation is as follows: If a current circulates through the main branch S_1, the electro-magnet M attracts the anchor B to one side, so that the contact screws attached to the other end are separated from one another, and the whole side circuit $S_1 + S$ is inserted. If the resistance in the flame be increased, or if the current in the main branch be interrupted from any cause, then the attraction of the electro-magnet ceases entirely, or else the counterpoise Q overcomes the attraction of the electro-magnet, and thus the anchor B is broken off, and by the contact screws a portion of the side circuit S_2 is suddenly closed. The united currents then circulate only through a portion of the side bobbin (restored with stronger copper wires) by which the carbons are drawn nearer together, or, in case this should not take place, a free course is left for the passage of the current through the lamp.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

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PROSPECTIVE.

The prospect of an unlimited number of telegraph cables beneath the Atlantic has set the English newspapers gushing in a manner that will gladden the heart of American speculators. On the other hand, the prospect of innumerable wires above our public thoroughfares is provoking so much animadversion that the enterprising projectors at home are beginning to take alarm. Newspapers are irresponsible entities; municipalities are, or may be made to be, responsible bodies. It is very nice to have matter for leading articles dropping in at the dull season, and to get paid for them; it is not so nice to have impending lawsuits on hand for damages that have to be paid for. In a general way it is highly satisfactory to know that professional leader writers are an impecunious race, who have no money to invest, and no interests to serve, so they tell us, but the tastes of their readers. From a shareholder's point of view, however, it would have a very steadying effect upon the irrepressible journalist if he would back his opinions with money down. The advocacy of an overland route from Baffin's Bay to Siberia by way of the North Pole would be greatly strengthened if the reader were assured that shares in the venture had been applied for by its advocate. Similarly, the praises of unlimited competition would come with more emphasis if the enthusiast had any capital in the property to be run down. Perhaps on the whole, however, things are better as they are, the moralities as well as the verbosities being allowed free play. Still, we cannot help remarking on the oddities of that system of ethics which sees much turpitude in risking the downfall of a chimney-stack, and the consequent breaking of a head or two, but discerns no wrong in the certain downfall of a million or so of money, and the inevitable breaking of numberless hearts. We could wish that our public instructors were burdened with consciences like other people; but as this may not be, we can only hope that the progress of events which he is ever belauding will one day bring even the journalist to his proper level.

Perhaps we are nearer that consummation than he at present dreams of. One of the writers we are referring to told us the other day that we were on the eve of a well-nigh universal system of telegraphy, reaching every coast washed by the seas, and invading every corner of the earth where civilisation may dawn. News, news, news, was the burden of our writer's cry. So ardent is the public craving for news, and so urgent the duty of the newspaper to satisfy the public appetite that wires must be carried not only to the farthest but to the darkest corners of the earth. It is assumed that everybody capable of reading is anxious to know everything that goes on everywhere. We greatly doubt it. We can easily imagine a period when news will be so abundant that nobody will relish it. Nay, have we not almost arrived at that era already? It is even now almost impossible to get up a genuine sensation, so voluminous are the materials reaching us from one quarter or another every day. Sixty columns of details concerning the doings of this bullet—"of the calibre called 42"—have failed to excite a tithe of the emotion which 16 years ago was evoked by half-a-dozen words telling us that President Lincoln was shot. There is a limit to human sympathy, and if things march on at their present pace we may expect to hear a general demand for wooden kings, stuffed presidents, and cast-iron czars out of sheer inability to follow the minutiæ of human sufferings. But these are familiar personages. What of the boundless unfamiliar, about which nobody knows and nobody at present cares? Can the newspapers arouse our interest in the excursions of nomads, the festivities of cannibals, and the scalpings of noble savages? Will the scandals of far distant harems, the crises in every celestial cabinet, and the intrigues of courtly barbarians from Bambarra to Mandchouria—to say nothing of ceaseless wars which are the chief events on at least a quarter of the habitable earth—will it be possible, we ask, to strain our overtaxed sensibilities, or quicken our languid attention, to the extent predicted by the sanguine newspaper writer? We sincerely hope it may; but as telegraphic enterprise cannot prosper on "press rates" alone, it is to be hoped that the dream of the newsvendor may not be over quickly realised. Commerce and the relations growing naturally out of civilised life are remunerative; mere gossip never has been and probably never will be profitable—not at all events to the carrier.

The possibilities of overdoing international telegraphy may thus be checked by the dictates of common business considerations. This, unfortunately, is not the case with respect to what may be called housetop telegraphy. Here the extensions will go ahead as long as people will pay, and so long as it is safe for foot passengers to walk under galvanised lassos. We do not want to discourage the telephone companies who, now that they have come to an equitable understanding with the Government, are doing a legitimate as well as useful business; but we may point out that the time cannot be far distant when the capabilities of chimney stacks and house gables will be exhausted—when, too, the

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risk to which Parliament has already had its attention drawn will have become an unendurable peril. Even if these rocks are weathered there is the other prospective likelihood that, though the public may consent to have their buildings eternally disfigured, they will finally protest against having the breath of life and the light of day doled out to them through an iron sieve. There are bye streets, and even large open spaces in London city already so covered with network overhead that a fair view of the sky has not been had for a twelvemonth past. It is almost a mechanical certainty that these wires are not exempt from the ills which befall—otherwise harmlessly—the cross-country telegraphs; they will come down with a run, and so will the companies' shares. The local rates, we believe, profit by the erection of overhead wires; but when the local authorities discover, as appears likely they will do, that they are responsible for the risks they have condoned by reason of the taxes they have pocketed, we know very well what will happen. Would it not be wiser to anticipate the evil day by beginning to agree upon a system of subways? The terrors of induction, and the exigencies of lively competition might excuse want of foresight in the first instance; but these excuses hardly serve any longer; and it behoves the various interests concerned to consider their ways in time. As a makeshift, even carrying wires below the copings would be preferable. The cost would be greater, but the life would be longer; and seeing that it is impossible to continue defying public opinion and public safety indefinitely, some alternative plans ought to be speedily adopted. The opinion of the journalist in this relation may be trusted; he is sure to take sides against the proprietors, and when the time comes will overwhelm them with unreasonable, but highly effective, denunciation.

M. FAURE'S BATTERY.—A CORRECTION.

We are glad to be able to correct an error made by the contributor of the article on "The Storage of Electricity" in our issue of June 25. In the last sentences it is stated that the patent can hardly be valid in England because of publication. The date of the first patent is Jan. 11th, 1881, and this was followed by others in Feb. or April, before which time, so far as we can ascertain, no description had been published which could invalidate the patent.

MODIFICATIONS OF DANIELL'S CELL.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I can recommend the form of gravity cell described by Dr. Moser at the meeting of the Physical Society, June 25, as I have used for nearly three years 100 cells of the same form (only with the addition of sand between the copper and zinc) for the electrification of my electromoter needles.* This battery was made and charged in 1878, and has lost but little in E.M.F. since.

I got the idea from Sprague's "Electricity," where there is a cell described with two porous pots, one within the other, the intermediate space being filled with zinc cuttings.—Yours, &c. J. BROWN.

Belfast, July 5, 1881.

* See *Phil. Mag.* for February, 1879.

CONVERSAZIONE AT KING'S COLLEGE.

On Saturday, July 2, the Council and Academical Staff of King's College had their distribution of college prizes by His Royal Highness the Prince of Wales, who was accompanied by Her Royal Highness the Princess of Wales. They were very much interested in the exhibition of incandescent lamps, lighted by means of Faure's secondary battery, which was shown to them in the Wheatstone Laboratory by Professor Adams.

This was followed in the evening by a brilliant conversazione, when many excellent pictures and works of art were exhibited, and a number of interesting scientific experiments were performed. The Entrance Court and Entrance Hall of the college were lit up by three Crompton lamps, which worked very steadily during the evening, and were the subjects of much praise. The Museum of King George III. contains an unrivalled collection of mechanical and physical apparatus, and is especially rich in apparatus of historic interest. The nucleus of the collection was presented to the College by Her Majesty the Queen, in 1843, when the museum was opened by Prince Albert, who then witnessed some of the experiments of Sir Charles Wheatstone with the electric telegraph. Important additions have been made to the collection of apparatus by the professors of natural philosophy, and at his death Sir Charles Wheatstone's valuable collection was bequeathed to the museum.

Among the interesting features in the museum are—Calculating machines of Cavendish and others, Appold's centrifugal pump, Newcomen's model of his steam engine, original forms of Daniell's battery, Siberian loadstone used for his induction spark by Faraday, original Wheatstone bridge, early forms of stereoscope, early forms of electrical machine, Polar clocks and shadow clocks, De Kempelen's talking machine.

Among the interesting apparatus exhibited in the Physical Laboratory—now called the Wheatstone Laboratory—which was founded in 1868 by the Council, and which from its foundation has been under the direction of Professor Adams, were the following:—

Measuring polariscopes, with universal motions for exact measurement of crystals; an optical bench, showing interference of light; diffraction spectra; dynamo-electric machine; Wheatstone collection of apparatus for exhibition in Paris.

In the room adjoining the museum was placed a case containing various kinds of vacuum tubes, and among them a very beautiful coronet of tubes of uranium and other kinds of glass. The great event of the evening, however, in the physical department of the College, was the exhibition for the first time in England of the Faure secondary battery, or reservoir of electricity. This battery, consisting of two boxes which had been previously charged from a dynamo-electric machine, and afterwards brought to the College, was capable of heating to bright redness a platinum wire two metres long and about one millimetre in diameter. Six boxes were found sufficient to cause Swan electric lamps to glow brilliantly, and during the evening Professor Adams's lecture-room was illuminated by Swan lamps with the current from the battery; experiments were also made by M. Faure himself. Twelve boxes were employed in the Wheatstone laboratory to illuminate Lane Fox lamps, lent by the British Electric Light Company. It was shown that by means of these boxes of electricity the lighting of private houses by electricity is already an accomplished fact.

Besides these special attractions which Professor Adams had brought together, there were collections of apparatus by Elliott Brothers, by Tisley and Co., and by Browning, which were arranged in the Wheatstone Laboratory.

TELEPHONIC.—Professor Strong, of Chicago, claims to have recently discovered a practical method of transmitting and receiving telephonic messages through non-insulated wires placed in lakes or rivers.

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SECONDARY BATTERIES.

We are enabled by the kindness of our comtemporary, *La Lumière Electrique*, to illustrate both the Planté and the Faure Secondary Batteries, about which so much has been said of late. Figs. 1 and 2 represent the Planté cell. The preparation is as follows:—Two sheets of lead are laid the one on the other, separated by two strips of india rubber, the whole being rolled up as shown in Fig. 1. The roll having been completed, the cylinder used in its formation is withdrawn, and it is consolidated by a wrapper of gutta percha, and inserted in a glass jar filled with water and 1-10th part acid. An electric current is then made to pass through the cell, oxygen is given off and produces a thick cushion of peroxide of lead on one sheet; hydrogen is given off at the other sheet. If the current with which the cell has been charged be cut off, and the two sheets are connected, a current will be produced owing to the presence of the oxygen, which leaves the sheet where it has accumulated and attacks and oxidises the other sheet. This secondary current, which is very small at first, gains strength each time the operation is repeated; in course of time the surfaces of the sheets are changed, the one being covered with a cushion of peroxide of lead, the other with lead reduced to a spongy mass. The cell is now complete, and in a state of electrical accumulation.

Fig. 1

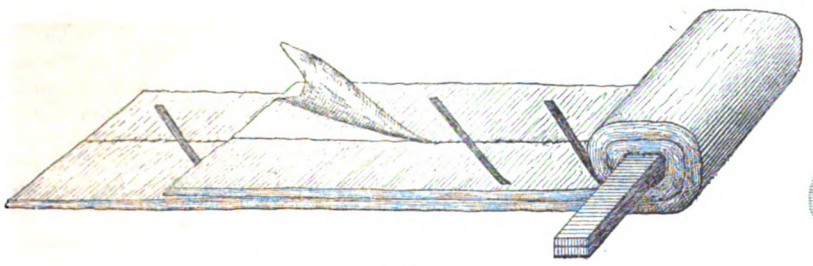

Fig. 3.

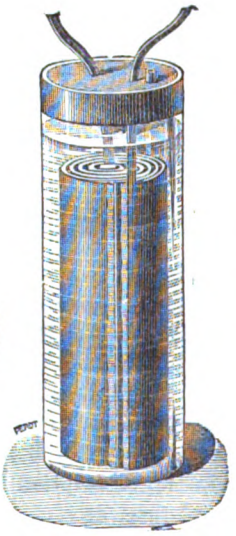

Fig 2.

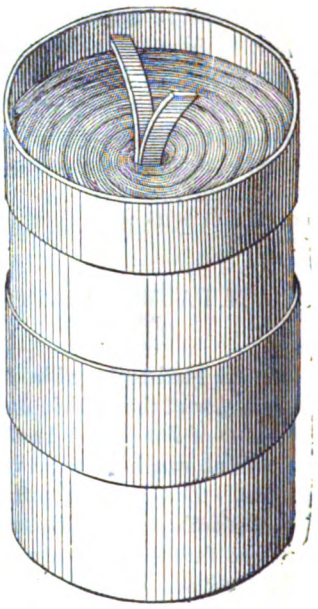

Fig. 4.

Subsequently M. Planté tried the plan of separating the two sheets of lead by canvas, the cell taking the form of Fig. 2. He next found that it was necessary to leave a small space between the sheets to provide for the escape of the gases which were produced at the end of the charge; subsequently india rubber bands were employed in preference to canvas. M. Planté also tried carbonate of lead, minium, &c., but without improving upon the results already obtained.

The Faure battery is very similar to the above, and is constructed thus:—Two sheets of lead are taken, 0·20m. large, the one about 0·60m. long and 0·001m. thick, the other 0·40m. long and 0·0005m. thick. Each of these is furnished with a strong strip of lead at one of its ends. Each sheet has a layer of red lead spread on its surface, the lead being made into a paste with water, the larger sheet having about 800 grammes on its surface, and the smaller 700 grammes. On each surface a sheet of parchment is laid, and the whole is introduced into a sheathing of thick felt. The sheets are laid one above the other; at the same time several bands of india rubber are placed in an oblique fashion, as shown in Fig. 3. The roll is placed in a leaden jar, strengthened by copper bands, and supplied in the interior with red lead and felt. The cell then presents the appearance shown in Fig. 4. One of the pieces of lead which jut out is curved and soldered to the outer jar, acidulated water is put in, and the battery is ready for work.

An account of some experiments with an extemporised Faure battery carried out recently in the office of the *Scientific American* may not be without interest here. We quote from our contemporary, which says:—"In attempting to follow M. Faure's plan of construction some difficulty was experienced in making the red lead remain in place during the rolling up of the two electrodes. Therefore, the battery was constructed of square plates of lead, each having an ear projecting upward from one side, for attachment to a binding post. This plan succeeded very well, the flat plates having the advantage of retaining a great quantity of red lead and of being easily formed into a compact pile. The plates employed were of pure lead foil, having the thickness of a postal card, a width of 7 inches, a height of $7\frac{1}{8}$ inches, with an ear projecting from the top $1\frac{1}{2}$ inch wide and 3 inches high. The total effective surface on both sides and edges of each plate was 100 square inches. Ten such plates were sufficient for a single element for ordinary uses, and such an element may be fairly charged by means of four gravity cells, but a stronger current is much quicker and more satisfactory. The method followed in building up these secondary elements was as follows:—

After cutting out a sufficient number of lead plates, pieces of canton flannel, 15 inches long and $7\frac{1}{2}$ inches wide, were cut, and finally as many sheets of blotting paper, $7\frac{1}{2}$ inches square, as there were lead plates were provided. The next step was to prepare a thick paint of red lead by mixing the dry pigment with water containing one-tenth of sulphuric acid. This paint had a consistency of paste, and was applied thickly to one side of the sheet of lead with a common flat paint brush.

"The canton flannel having been painted to within one-quarter inch of all its edges on the nap side, the lead was laid, painted side down upon the painted canton flannel, when the other side of the lead was painted and the cloth was neatly folded over the lead, completely enveloping it with the exception of the ear at the top, and projecting about one-quarter inch beyond all the edges of the lead. The lead with its envelope was then laid upon a level board, and another plate was prepared in the same manner and placed over the first, with an intervening layer of blotting paper, and with the ear placed opposite the ear of the first. Other lead plates were added in the same way, with the interposed sheet of blotting paper and with the ears alternating in position.

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When ten plates had been placed together in this manner they were clamped together with two or three elastic bands, and the ears were brought together and passed through a slit in the wooden cover of the containing cell and bent down upon the top of the cover. They were then pierced and traversed by the screw of a binding post which entered the wood. In this way each pole of the element was furnished with a binding post, and at the same time firmly secured to the cover. The cell was then partly or wholly filled with acidulated water—water 10 parts, sulphuric acid 1 part — and after the cloth and blotting paper had become saturated the element was connected with four gravity cells. In one hour the element had stored electricity sufficient to heat $1\frac{1}{2}$ inch of fine platinum wire to redness, to work a magnet strongly, and to run at a high rate of speed for fifteen minutes a small electric motor that requires at least ten gravity cells to operate it. After this preliminary experiment a number of the new secondary elements were prepared in the same way and charged separately with a dynamo-electro machine. One element of ten plates, after receiving the current from the dynamo for ten minutes, operated the small motor above referred to for something over three hours.

"Another ten minutes' application of the current from the dynamo charged it so that after eighteen hours of rest it yielded a current which seemed as strong as when it was first charged on the previous day; but a time test proved that it was incapable of running the motor for quite so long a time as when the current is used soon after storing."

It will be seen from an account of the *conversazione* at King's College last Saturday, that the Faure secondary battery was very successfully used, and we may say that it has also been exhibited and used to light up Swan and Maxim lamps at the house of Mr. Spottiswoode, the President of the Royal Society. The Princess Louise was present and witnessed this exhibition, which was again very successful. On Wednesday last we saw certain experiments with the battery at the rooms of the British Electric Light Company, Heddon-street. A number of cells were used to give the current necessary for lighting a large group of Lane Fox's lamps, and proved admirably suited for the purpose. It is intended to exhibit the battery in premises taken by the Company formed to work M. Faure's patents, in the Strand.

The batteries used in the experiments at Heddon-street were charged by means of a dynamo-electric machine. Further information is promised relating to this battery, and we trust to be able to keep our readers well acquainted with the facts concerning it.

THE CONSERVATION OF ELECTRICITY.

The following letter appeared in *Nature* of the 23rd of June, in reply to one from M. Lippmann which we reproduced in our last issue:—

"I wish to take the earliest opportunity of responding to the courteous letter of M. Lippmann, which appears in the current issue of *Nature*, with the acknowledgment that his quotation from the *Comptes Rendus* of 1876 establishes in the most conclusive manner his priority of date in the enunciation of the doctrine of the Conservation of Electricity. As to my own independent enunciation of this doctrine, it was arrived at without any knowledge of the comparison drawn by M. Lippmann in 1876 between the cyclical flow of heat (of Carnot's theorem) and the cyclical flow of electricity. I approached the matter upon somewhat different and less clearly defined lines, and finally struck upon the fundamental notion of the conservation of electricity when endeavouring to think out the relations between electromotive and ponderomotive force in an electric theory of radiation based upon Clerk Maxwell's electro-magnetic theory of light. My speculations on this point were committed to writing some weeks ago, and will shortly be published. I content myself in the meantime with pointing out how near Clerk Maxwell came to a similar conclusion. In Article 35 of his well-known treatise, he says emphatically: 'While admitting electricity, as we have now done, to the rank of a physical quantity, we must not too hastily assume that it is, or is not, a substance, or that it is, or is not, a form of energy, or that it belongs to any known category of physical quantities. All that we have hitherto proved is that *it cannot be created or annihilated* (the italics are mine)'. Nevertheless the immediate and logical conclusion that electricity, like matter and like energy, is subject to a law of conservation appears to have been rejected by Clerk Maxwell for reasons explained in Article 574 of his treatise, consequent on his inability to discover whether an electric current possessed momentum or could exert a mechanical reaction upon the matter of the conductor through which it flows. The unfortunate dilemma which suggested this experiment could hardly have been raised if it had been as clearly understood as it now is that there is the same distinction between electro-kinetic and ponderokinetic energy as between electromotive and ponderomotive force. But to discuss this matter further would lead me to take up too much space.

"SILVANUS P. THOMPSON.

"University College, Bristol, June 19."

ON THE MODERN DEVELOPMENT OF FARADAY'S CONCEPTION OF ELECTRICITY.*

BY PROFESSOR HELMHOLTZ.

(CONTINUED FROM PAGE 108.)

Hitherto we have studied the motions of ponderable matter as well as of electricity going on in an electrolyte.

Let us now study the forces which are able to produce these motions. It has always appeared somewhat startling to everybody who knows the mighty power of chemical forces, and the enormous quantity of heat and mechanical work which they are able to produce, how exceedingly small is the electric attraction at the poles of a battery of two Daniell cells, which, nevertheless, is able to decompose water. One gram of water, produced by burning hydrogen with oxygen, develops so much heat, that this heat transformed by a steam engine into mechanical work would raise the same weight to a height of 1,600,000 metres, and on the contrary we require to use the most delicate contrivances to show that a gold leaf, or a little piece of aluminium hanging on a silk fibre, can be at all moved by the electric attraction of the battery. The solution of this riddle is found if we look at the quantities of electricity with which the atoms appear to be charged.

The quantity of electricity which can be conveyed by a very small quantity of hydrogen, when measured by its electrostatic forces, is exceedingly great. Faraday saw this, and endeavoured in various ways to give at least an approximate determination. He ascertained that even the most powerful batteries of Leyden jars, discharged through a voltameter, give scarcely any visible traces of gases. At present we can give definite numbers. The electrotechnical equivalent of the electromagnetic unit of the galvanic current has been determined by Bunsen, and more recently by other physicists. This determination was followed by the very difficult comparison of the electromagnetic and electrostatic effects of electricity, accomplished at first by Professor W. Weber, and afterwards under the auspices of the British Association by Professor Clerk Maxwell.† The result is

* From the *Chemical Society's Journal*.

† According to the latest and most careful measurements of the electro-chemical effect, performed by Professor Kohlrausch, jun., the electro-magnetic unit of the galvanic current, as it was defined by W. Weber (= 0·1 of the British Association unit), decomposes 0·009476 mgrm. of water per second. This same unit current of Weber transfers about $300 \cdot 10^9$ electrostatic units of electricity (Weber himself gave $311 \cdot 10^9$, Maxwell $288 \cdot 10^9$) through each section of the circuit per second, half of them being positive, half of them negative, the two halves going in opposite directions. The electrostatic unit introduced by Gauss and W. Weber is that quantity of electricity which repels the same quantity at the distance of one millimeter with unit force, that is, with a force which, acting during one second upon one milligram, transmits to it a velocity of one millimeter per second. Gravity acting upon one milligram produces an acceleration 9,809 times as great. Weber's unit force, therefore, is equal to $\frac{1}{9809}$ of the weight of one milligram. The force F, measured by weight, with which the electric quantity, + E,

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that the electricity of 1 mgrm. of water, separated and communicated to two balls 1 kilom. distant would produce an attraction between them equal to the weight of 26,800 kilog.

As I have already remarked, the law that the intensity of the force is inversely proportional to the square of the distance, and directly proportional to the quantities of attracting and of attracted mass, holds good as well in the case of gravitation as in that of electric attraction and repulsion. We may, therefore, compare the gravitation acting between two quantities of hydrogen and oxygen with the attraction of their electric charges. The result will be independent of the size and the distance of these quantities. We find that the electric force is as great as the gravitation of ponderable masses, being 71,000 billion times greater than that of the oxygen and hydrogen* containing these electric charges.

The total force exerted by the attraction of an electrified body upon another charged with opposite electricity is always proportional to the quantity of electricity contained on the attracting as on the attracted body. Although, therefore, the attracting forces exerted by the poles of a little battery able to decompose water on such electric charges as we can produce with our electric machines are very moderate, the forces exerted by the same little apparatus on the enormous charges of the atoms in one milligram of water may very well compete with the mightiest chemical affinity. If we now turn to investigate how the motions of the ponderable molecules are dependent upon the action of these forces, we must distinguish two different cases. At first we may ask what forces are wanted to call forth motions of the ions with their charge through the interior of the fluid; secondly, what are wanted to separate the ion from the fluid and its previous combinations? Let us begin with the case in which the conducting liquid is surrounded everywhere by insulating bodies. Then no electricity can enter, none can go out through its surface, but positive electricity can be driven to one side, negative to the other, by the attracting and repelling forces of external electrified bodies. This process going on as well in every metallic conductor is called "electrostatic induction." Liquid conductors behave quite like metals under these conditions, great quantities of electricities are collected, if large parts of the surfaces of the two bodies are very near to each other. Such an arrangement is called an electric condenser. We can arrange electric condensers in which one of the surfaces is that of a liquid, as Messrs. Ayrton and Perry have done lately. The water dropping collector of electricity, invented by Sir W. Thomson, is a peculiar form of such a condenser, which can be charged with perfect regularity by the slightest electromotive force, perceptible only to the most sensitive electrometer. Professor Wüllner has proved that even our best insulators, exposed to electric forces for a long time, are ultimately charged quite in the same way as metals would be charged in an instant. There can be doubt that even electromotive forces less than $\frac{1}{1000}$ Daniell produce perfect electrical equilibrium in the interior of an electrolytic liquid.

Another somewhat modified instance of the same effect is afforded by a voltametric cell containing two electrodes of platinum, which are connected with a Daniell cell the electromotive force of which is insufficient to decompose the electrolyte. Under this condition the ions carried to the electrodes cannot give off their electric charges. The whole apparatus behaves, as was first accentuated by Sir W. Thomson, like a condenser of enormous capacity. The quantity of electricity, indeed, collected in a condenser under the same electromotive force is inversely proportional to the distance of the plates. If this is diminished to $\frac{1}{100}$ the condenser takes in 100 times as much electricity as before. Now, bringing the two surfaces of platinum and of the liquid into immediate contact, we reduce their interval to molecular distances. The capacity of such a condenser has been measured by Messrs. Varley, Kohlrausch, and Colley. I have myself made some determinations which show that oxygen absorbed in the fluid is of great influence on the apparent value. By removing all traces of gas I have got a value a little smaller than that of Kohlrausch, which shows that if we divide equally the total value of the polarisation between two platinum plates of equal size, the distance between the two strata of positive and negative electricity, the one lying on the last molecules of the metal, the other on those of the fluid, ought to be a ten millionth part (Kohlrausch $\frac{1}{10000000}$) of a millimeter. We always come nearly to the same limit when we calculate the distances through which molecular forces are able to act, as already shown in several other instances by Sir W. Thomson. Owing to the enormous capacity of such an electrolytic condenser, the quantity of electricity which enters into it, if it is charged even by a feeble electromotive force, is sufficiently great to be indicated easily by a galvanometer. What I now call charging the condenser I have before called polarising the metallic plate. Both, indeed, are the same process, because electric motion is always accompanied in the electrolytes by chemical decomposition.

Observing the polarising and depolarising currents in a cell like that represented in Fig. 1, we can observe these phenomena with the most feeble electromotive forces of $\frac{1}{1000}$ Daniell, and I found that down to this limit the quantity of electricity entering into the condenser was proportional to the electromotive force by which it was collected. By taking larger surfaces of platinum, I suppose it will be possible to reach a limit much lower than that. If any chemical force existed besides that of the electrical charges which could bind all the pairs of opposite ions together, and required any amount of work to be vanquished, an inferior limit ought to exist to such electromotive forces as are able to attract the ions to the electrodes, and to charge these as condensers. No phenomenon indicating such a limit has as yet been discovered, and we must, therefore, conclude that no other force resists the motions of the ions through the interior of the liquid than the mutual attractions of their electric charges. These are able to prevent the atoms of the same kind which repel each other from collecting at one place, and atoms of the other kind attracted by the former from collecting at any other part of the fluid, as long as no external electric force favours such distribution. The electric attraction, therefore, is able to produce an equal distribution of the opposite constituent atoms throughout the liquid, so that all parts of it are neutralised electrically as well as chemically.

On the contrary, as soon as an ion is to be separated from its electrical charge, we find that the electrical forces of the battery meet with a powerful resistance, the overpowering of which requires a good deal of work to be done. Usually the ions, losing their electric charges, are at the same time separated from the liquid; some of them are evolved as gases, others are deposited as rigid strata on the surface of the electrodes, like galvanoplastic copper. But the union of two constituents having powerful affinity to form a chemical compound, always produces, as you know very well, a great amount of heat, and heat is equivalent to heat.

On the contrary, decomposition of the compound substance requires work, because it restores the energy of the chemical forces which has been spent by the act of combination. Oxygen and hydrogen separated from each other contain a store of energy, for on burning the hydrogen in the oxygen they unite, form water, and develop a great amount of heat. In the water

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measured in electrostatic units, attracts the opposite quantity, $-E$, at a distance r, is equal to

$$F = \frac{E^2}{r^2} \cdot \frac{1}{9\,8\,0\,6\,6\,5} \text{ mgrm.}$$

If E is the quantity carried to each electrode during the decomposition of one milligram of water, it is, according to the determinations quoted before, $= 1618 \cdot 10^{10}$ units, and if we put r = 1 kilometer = 1,000,000 millimeters, we get the result quoted above.

* The gravity of a weight, m, is the force of attraction between it and the mass of the earth, which may be considered as concentrated in the central point of the earth. If h is the mean density of the earth, and r its radius, the mass of the earth will be:—

$$\frac{4}{3}\pi r^3 . h.$$

If G is the force of attraction between two units of mass at unit of distance the attraction of the mass m by the earth will be:—

$$g\,m = \frac{4}{3}\pi r h . G\,m.$$

Take

$$\frac{\pi}{2} r = 10^7 \text{ meters} = 10^{10} \text{ mm.}$$

$$h = 5{\cdot}62 \text{ mgrms. per cub. mm.}$$

the attraction between $\frac{8}{9}$ mgrm. of oxygen and $\frac{1}{9}$ mgrm. of hydrogen contained in 1 mgrm. of water, and separated by a distance of 1 mm. will be

$$\frac{1}{9} \cdot \frac{8}{9} . G = \frac{g}{27{\cdot}5,\ 62{\cdot}10^{20}}$$

or equal to the weight of

$$\frac{65904}{10^{17}} \text{ mgrm.}$$

The attraction of the electric charges, which has been calculated before for a distance of 1 kilometer, reduced to that of 1 mm., will be equal to the weight of $20800 \cdot 10^{18}$ mgrms. From this it follows that the attraction by gravitation of those two masses would become equal to the attraction of their electric charges, if each of the masses could be increased 71,300 billions of times.

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the two elements are contained, and their chemical attraction continues to work as before, keeps them firmly united, but can no more produce any change, any positive action. We must reduce the combined elements into their first state, we must separate them, applying a force which is capable of vanquishing their affinity before they are ready to renew their first activity. The amount of heat produced by the chemical combination is the equivalent of the work done by the chemical forces brought into action. It requires the same amount of work to separate the compound and to restore hydrogen and oxygen uncombined. I have already given the value of this amount calculated as a weight raised against the force of gravity.

Metals uniting with oxygen or halogens produce heat in the same way, some of them, like potassium, sodium, and zinc, even more than an equivalent quantity of hydrogen; less oxidisable metals, like copper, silver and platinum less. We find, therefore, that heat is generated when zinc drives copper out of its combination with the compound halogen of sulphuric acid, as is the case in a Daniell cell. If a galvanic current passes through any conductor, a metallic wire, or an electrolytic fluid, it evolves heat. Dr. Joule was the first who proved experimentally that if no other work is done by the current, the total amount of heat evolved in a galvanic circuit during a certain time is exactly equal to that which ought to have been generated by the chemical actions which have been performed during that time. But this heat is not evolved at the surface of the electrodes where those chemical actions take place, but is evolved in all the parts of the circuit, proportionally to the galvanic resistance of every part. From this it is evident that the heat evolved is an immediate effect not of the chemical action, but of the galvanic current, and that the chemical work of the battery has been spent to produce only the electric action. To keep up an electric current through an electric conductor, indeed, requires work to be done. New stores of positive electricity must be continually introduced at the positive end of the conductor, the repulsive force acting upon them having to be overcome; negative electricity, in the same way, into the negative end. This can be done by mere mechanical force, with an electric machine working by friction, or by electrostatic or by electromagnetic induction. In a galvanic current it is done by chemical force, but the work required remains the same. If we apply Faraday's law, a definite amount of electricity passing through the circuit corresponds with a definite amount of chemical decomposition going on in every electrolytic cell of the same circuit. According to the theroy of electricity the work done by such a definite quantity of electricity which passes, producing a current, is proportionate to the electromotive force acting between both ends of the conductor. You see, therefore, that the electromotive force of a galvanic circuit must be, and is, indeed, proportional to the heat generated by the sum of all the chemical actions going on in all the electrolytic cells during the passage of the same quantity of electricity. In the cells of the galvanic battery chemical forces are brought into action able to produce work; in cells in which decomposition is occurring, work must be done against opposing chemical forces. The rest of the work done appears as heat evolved by the current, as far as it is not used up to produce motions of magnets or other equivalents of work.

You see the law of the conservation of energy requires that the electromotive force of every cell must correspond exactly with the total amount of chemical forces brought into play, not only the mutual affinities of the ions, but also those minor molecular attractions produced by the water and other constituents of the fluid. These minor attractions have lately formed the subject of most valuable and extended calorimetric researches by Messrs. Andrews, Thomsen, and Berthelot. But even influences too minute to be measured by calorimetric methods may be discovered by measuring the electromotive force. I have myself deduced from the mechanical theory of heat the influence which the quantity of water contained in a solution of metallic salts has on the electromotive force. The chemical attraction between salt and water can be measured in this instance by the diminution of the tension of the aqueous vapours over the liquid; and the results of the theoretical deduction have been confirmed in a very satisfactory manner by the observations of Dr. James Moser. Hitherto we have supposed that the ion with its electric charge is separated from the fluid. But the ponderable atoms can give off their electricity to the electrode and remain in the liquid, being now electrically neutral. This makes scarcely any difference in the value of the electromotive force. For instance, if chlorine is separated at the anode, it will at first remain absorbed by the liquid; if the solution becomes saturated, or if we make a vacuum over the liquid, the gas will rise in bubbles. The electromotive force remains unaltered. The same may be observed with all the other gases. You see in this case that the change of electrically negative chlorine into neutral chlorine is the process which requires so great an amount of work, even if the ponderable matter of the atoms remains where it was. On the contrary, if the electric attraction does not suffice to deprive the ions collecting at the surface of the electrodes of their electric charge, you will find the cation attracted and retained by the cathode, the anion by the anode, with a force far too great to be overpowered by the expansive force of gases. You may make a vacuum as perfect as you like over a cathode polarised with hydrogen, or an anode polarised with oxygen; you will not obtain the smallest bubble of gas. Increase the electric potential of the electrodes, so that the electric force becomes powerful enough to draw the electric charge of the ions over to the electrode. The ions will be liberated and free to leave the electrode, passing into the gaseous state or spreading in the liquid by diffusion.

(TO BE CONTINUED.)

THE ELECTRIC LIGHT AND POWER GENERATOR COMPANY (LIMITED).

The first general meeting of the shareholders of the above-named Company was held at the Cannon-street Hotel, on Tuesday, the 5th instant, to appoint auditors, fix their remuneration, and transact general business. Admiral Sir E. A. Inglefield, C.B., D.C.L., F.R.S., the Chairman of the Company, presided.

The SECRETARY (Mr. F. H. Landon) having read the notice convening the meeting,

The CHAIRMAN said:—The first ordinary general meeting of the shareholders of the Electric Light and Power Generator Company has been called, according to Act of Parliament, within four months of the formation of the Company. Your Directors have anticipated the date when it would have been necessary that you should be called together, as there are certain amendments in the Articles of Association which appear to need some slight alteration so as to meet the requirements of the Stock Exchange, and these will be put before you so soon as the business of the general meeting shall be concluded, and when an extraordinary general meeting will be convened for the purpose. My duty now is to give you a general outline of our proceedings since the formation of the Company. The whole capital was quickly taken up, and I think I may draw your attention to the fact that, while in most cases of a first or statutory meeting of the shareholders of a newly-formed company for working an entirely new undertaking there is seldom much more to report than a statement as to the capital which has been subscribed, and certain preliminary arrangements, we are in a position to show you that rapid strides have been made towards placing this Company not only in a highly advantageous light before the public, as a "going" concern with daily increasing prospects of unqualified success, but we are able to point out to you remunerative works already nearly completed, and only incomplete because we are dependent upon outside contracts. There are also other positions where we have made our mark, so that not only shareholders but every inquirer may learn for himself how successful have been the efforts of the Directors of the Electric Light and Power Generator Company. In the first place, we would call your attention to the premises, No. 29, Bankside, of which your Directors have obtained a lease for seven years on very favourable terms, and where not only the engines, dynamic machines, lamps, &c., have been brought together for the completion of the City contract to light Southwark Bridge, Queen Victoria-street, Queen-street, and Queen's-street-place, but the necessary instruments for lighting Farringdon-street, Aldersgate, and Moorgate Stations have been fitted in the shops, which are now rapidly approaching such a state of efficiency that we shall be prepared to accept and carry out any work that may be brought before us. It would not be proper at this moment to speak of what we have actually in prospect, but I may say that from large towns, factories, and private individuals we have repeated applications, thus promising an amount of business so large and comprehensive that our only doubt is whether we may not shortly find it necessary to acquire larger works in another district. Your Directors are fully alive to the importance of making the Electric Light and Power Generator Company second to none in existence; and with that view they have spared neither time, trouble, nor prudent expenditure in obtaining all the newest and most valuable of the modern patents for street and domestic lighting; and they are of opinion that they possess what will ultimately prove the most complete system of electric lighting for these purposes. The original prospectus set forth the successful use of the Lontin and Rapieff systems as tried in Paris at the Gare de Lyons, the Place du Caroussel, the Gare St. Lazare, and many other points; and although these systems have been in use by the Metropolitan Railway Company at Aldersgate Station for upwards of a year, and at *The Times* Office in Printing House-square, over two years, still there are many points in which great improvements have been made in the formation of new machines and lamps, and such improvements have been adopted in our latest apparatus employed for lighting. Your Directors are unable at this moment to put before you any statistics from their own experience as to the great advantages of electric lighting over gas lighting. This, however, is an acknowledged fact, and taking the figures shown by another company, whose instruments and process of lighting is similar in all essentials to ours, we may for a moment draw your attention to a published statement. The electric lighting at the South Kensington Museum, and which had been carried on for nine months by the Brush system, is a good example. In an official report to the Lords of the Committee of Council on Education it has been given that the annual saving between the new process of lighting by electricity in the place of gas has amounted to a gross sum of £325 16s. 4d., gas having cost when used £500 per annum, while the electric lighting amounted to £234 3s. 8d., with all its many other advantages, such as cleanliness, safety from fire, and harmlessness with reference to books, furniture, and decorations. In conclusion, you may be assured that nothing will be spared in pushing the

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operations of the Company as far as the capital will admit, so that the greatest amount of work may be put out of hand in the most profitable form, having always in view the lasting and increasing stability of the Electric Light and Power Generator Company.

Mr. WILLIAM ABBOTT asked when the company would light the City, in accordance with their contract? He mentioned that by the introduction of electric light into some large iron works in Wales several thousands a year had been saved. He also asked if any information could be given to the shareholders concerning the new battery or accumulator.

The CHAIRMAN: We had hoped by the 1st of July to commence the City lighting, but where you are disappointed in getting your contracts fulfilled—some of them in Scotland and in various parts of the country, for producing castings and machines necessary to perfect the apparatus—the power is really out of our hands to say positively the day. Your Directors, however, are working unceasingly with the object of completing the City lighting at the very earliest period, and Professor Crookes, who was up nearly all last night taking tests of the cables, informs me that it will not now be many days before we can begin to light. Nothing will be spared in time and trouble, and I assure you that we are as anxious as any shareholder can be to see the City lighted. As to the Maxim patents, it is quite true that a report has gone abroad that we are in possession of them. That, however, is not altogether correct. The fact is that the negotiations are going on, and we hope we shall sooner or later possess the patents, to work them out for domestic lighting. I am able to say nothing more at present with respect to the actual completion of such an arrangement. We are anxious to see the arrangement carried out, and are making such arrangements for domestic lighting that I hope you may hear that a plot of land has been taken in a very important part of the town for commencing domestic lighting. I will ask Professor Crookes to reply to the other question.

Professor CROOKES, F.R.S.: As to the new battery—I suppose the Faure battery—the box of a million foot pounds that we have read of is referred to. I may say that as a company we have nothing to do with it. It would be of very great value if it were to come into use in some cases. It is not exactly a battery but a system for accumulating a large store of electricity, and then drawing it off at one's own pleasure. At present the electricity comes from a dynamo machine, like water from a high pressure service. The Faure battery is a reservoir of electricity, like a water cistern is of water, it stores it up, and it can be drawn out and replenished at pleasure. It will be of extreme use in connection with the Maxim patent. At a private house last night (I am not at liberty to say where, as the meeting was private), I saw a most satisfactory experiment tried with the Faure battery. It had come over especially from Paris. A series of Maxim lights were put on it, and seven of Faure's boxes were used to light them. The light was as brilliant as we are accustomed to see with the incandescent light. Another box was put on, and the light nearly doubled. The electrician thought it would not be safe to put on any more boxes, as any ordinary incandescent lamp would break down. I thought differently, knowing the capacity of the Maxim lamp to stand any current that might be put on it. At my instructions they accordingly put on other boxes, one after the other, and the light nearly doubled each time an additional box was added, till at last a series of lamps, which, under ordinary circumstances, would give a light of something less than 100 candles, gave a light equal to 1,200 candles. The light was increased twelvefold, and I have no doubt that we might have increased the light fortyfold without danger to the lamps. That is a very great advantage of the Maxim light. It will, I think, belong to us very soon, and then we shall be able to introduce it into this country either with or without the co-operation of the Faure accumulator.

In reply to another question,

The CHAIRMAN said though they were not actually possessed of the Maxim light, they had thought it well, with the possibility of what they hoped might eventually turn out, to make arrangements by which the light might be seen at a more convenient place than in the Euston-road. In a few days, therefore, they hoped to exhibit it at the Horticultural Company's premises in Regent-street.

Mr. E. H. WOODS asked a question with reference to the supplying power, and in reply

Professor CROOKES said: We have had no business communications with respect to supplying power, as this is quite a novelty. The electric light is not a novelty, but the subject of generating power is, and it will, therefore, require to be exhibited and advertised before the public take to it; but we have laid duplicate cables along Queen Victoria-street, put down specially for supplying power, and we hope to be able to exhibit the transmission of power in one or two places along the street. When the public see the value of it in that way I have no doubt that we shall do much more in it.

On the motion of Mr. W. ABBOTT, seconded by Mr. A. W. DADSON, Mr. Dever was appointed auditor of the Company.

An extraordinary general meeting was then held, when, on the motion of the CHAIRMAN, seconded by Mr. J. S. CAMPBELL, who made a few explanatory remarks, the following special resolution was passed:—

"That it is expedient to alter and amend the Articles of Association of the Company, as follows:—

"That the 35th Article be altered by substituting 'ten shillings' for 'twenty shillings' therein, and that the said 35th Article be and the same is hereby altered accordingly.

"That the 72nd Article be altered by omitting therefrom the words 'without previously disclosing in writing his interest to the other directors,' and that the said 72nd Article be and the same is hereby altered accordingly.

"That the 100th Article be altered by omitting therefrom the words 'And all Dividends unclaimed for three years after having been declared may be forfeited by the Directors for the benefit of the Company. A resolution of the Board to that effect shall be conclusive as against all persons claiming to be entitled to any such Dividend,' and that the said 100th Article be and the same is hereby altered accordingly.

"And that the 61st and 76th Articles of Association be and the same are hereby absolutely repealed and annulled."

The CHAIRMAN intimated that a special meeting would be held to confirm the resolution on the 25th inst. at the Works, Bankside.

On the motion of Mr. WILLIAM ABBOTT, a vote of thanks was passed to the Chairman and the Directors, and the proceedings then terminated.

THE EASTERN TELEGRAPH COMPANY (LIMITED).

Report of the directors to the eighteenth ordinary general meeting, to be held at the Terminus Hotel, Cannon-street, London, on Thursday, the 14th inst, at two o'clock in the afternoon:—1. The directors submit the accounts and balance sheet for the six months ended 31st March, 1881. 2. The Company's revenue for this period amounted to £302,158 18s. 3d., from which is deducted £67,754 0s. 7d. for the ordinary expenses of the Company, and £29,942 1s. 2d. expenditure on repairs of cables during the half year, and £3,276 5s. 6d. for income-tax, leaving £201,186 11s., which, together with £28,430 8s. 1d. brought forward from the preceding half year, gives a balance of £229,616 19s. 1d. From this balance £22,629 15s. has been paid for interest on debentures, and £20,473 17s. 6d. for dividend to 31st March, 1881, on the Preference shares, and £70,000 has been placed to the general reserve fund. This sum, with £18,771 13s. 9d. received during the half year for interest and profit on sale of investments, brings up that fund to £356,608 13s. 6d., and with the special reserves mentioned in the balance sheet makes the total amount of the reserves £392,060 12s. 3d. 3. The directors have, during the half year, paid an interim quarterly dividend of 1¼ per cent. on the ordinary shares. They now recommend the declaration of a final dividend for the year ended 31st March, 1881, of 2s. 6d. per share and a bonus of 1s. per share, both payable on the 15th instant, making, with the three previous payments on account, a total dividend for the year of 5¼ per cent. on the ordinary shares, and that the balance, £2,723 6s. 7d., be carried forward to the next account. 4. All the Company's cables are in good working order, with the exception of one of the cables between Aden and Bombay, which was recently interrupted in shallow water close to the Bombay shore, and will be speedily restored. 5. Reference was made in the last report to the Direct Lisbon Cable, which was broken off the coast of Portugal in 2,000 fathoms of water. The restoration of the line was completed by the s.s. "Chiltern" in May last. 6. The s.s. "Chiltern" has also been engaged in laying a cable from Sicily to the Island of Lipari, a distance of 23 miles, and a new 3-conductor cable across the Straits of Messina. These lines have been laid under agreements with the Italian Government, in consideration of the payment by the Government of subsidies amounting to £1,000 per annum for 30 years. The cost will be charged to revenue account. 7. The revenue includes £19,500 dividend and bonus for the half year upon the Company's shares in the Eastern and South African Telegraph Company, the dividend being at the rate of 6 per cent. per annum, with a bonus at the rate of 4 per cent. per annum. £30,000 has been placed to reserve, and £2,114 1s. 1d. carried forward. The Eastern and South African Company have paid over £16,633 6s. 8d. to the trustees of the sinking fund for redemption of the debentures. The total amount of the Company's reserves is now £59,014 15s. 5d. 8. The revenue account also includes £2,600 dividend for the half year on the shares of the Black Sea Telegraph Company belonging to this Company, by whom the line is worked and maintained under agreement.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices July 6.		Business Done Week Ending July 6. Highest.		Lowest.	
Anglo-American	52½	3½	53½		52½	
Do. Preferred	84½	85½	85½		83½	
Do. Deferred	24½	25½	25½		24½	
Brazil Submarine	10½	⅞	10⅞		10½	
Cuba	9½	⅞	9½		9½	
Do. Preference	16½	7½	17⅛		17⅛	
Direct Spanish	4½	5	—		—	
Do. Preference	13½	14⅛	—		—	
Direct United States Cable	10½	11	10½		10½	
Eastern Telegraph	10½	11	10½		10½	
Do. 6 per Cent. Preference	12½	13½	13		13	
Do. 5 per Cent. Debentures, 1899	106,	109	108		108	
Eastern Extension	11½	⅞	11⅛		11⅛	
German Union	11½	⅛	11⅛		11⅛	
Globe Telegraph and Trust Company	6½	⅛	6⅛		6⅛	
Do. Preference	12½	⅛	—		—	
Great Northern	13½	14	—		—	
Indo-European	28,	29	—		—	
Mediterranean Extension	2½	3	—		—	
Do. Preference	8½	9½	—		—	
Reuter's	11½	12½	12		12	
Submarine	280,	290	—		—	
West India and Panama	2,	⅛	2 1-16		2	
Do. 1st Preference	7⅛	⅛	—		—	
Western Brazilian	8¼	⅛	9 1-16		8 13-16	
West. Union 7 per Cent. 1st Mortgage	123,	128	—		—	
Do. 6 per Cent. Sterling Bonds	106,	110	—		—	

TRAFFIC RECEIPTS FOR JUNE, 1881.

Companies.	June, 1881.	June, 1880.	Increase.	Decrease
Anglo-American Telegraph Company	—	—	—	—
Cuba Submarine Company	£2,700	3,147	—	447
Direct Spanish Telegraph Company	1,456	1,277	179	—
Direct United States Cable Company	16,080*	6,520†	9,560	—
Eastern Telegraph Company	40,074	42,522	—	2,448
Eastern Extension Telegraph Company	29,339	29,100	239	—
Great Northern Telegraph Company	—	—	—	—

* At 2s. per word. † At 1s. 6d. per word.

THE EASTERN TELEGRAPH COMPANY (Limited).

NOTICE IS HEREBY GIVEN that the EIGHTEENTH HALF-YEARLY ORDINARY GENERAL MEETING of the EASTERN TELEGRAPH COMPANY (Limited) will be held on THURSDAY, the 14th July, 1881, at TWO O'CLOCK in the afternoon, at the Terminus Hotel, Cannon-street, London, when the Report and Accounts of the Directors will be presented, a Dividend declared, and the ordinary business of the Company transacted.

NOTICE is also given that the Register of Transfers will be closed from the 7th to the 14th July, both days inclusive.

By order of the Board,
GEORGE DRAPER, Secretary.

London, 5th July, 1881.

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RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

4116. AN IMPROVED METHOD OF AND MEANS FOR TRANSMITTING ELECTRICAL CURRENTS THROUGH CONDUCTORS, AND FOR FACILITATING THE ACTION OF INSTRUMENTS CONNECTED THEREWITH, *W. R. Lake.—Dated 9th October*, 1880.—(*A communication from L. Maiche.*) 6*d*.

This invention is chiefly designed for facilitating the transmission and reception of telephonic or telegraphic messages or signals, and consists in transforming at the starting station quantity currents of high tension produced by the battery into induced currents of high tension capable of overcoming the resistance of the line, also in the transformation of these induced high tension currents back into quantity currents on their arrival at the receiving station. Fig. 1 shows the means by which this is done on a telephone line. At the two stations a sending telephone, A, is placed in

4116

FIG 1

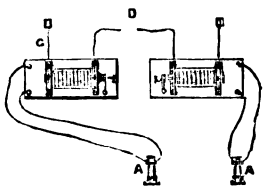
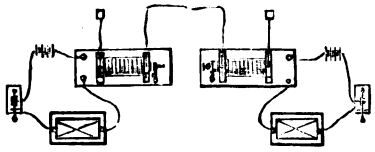


FIG.2



the circuit of the coarse wire of the induction coil. The fine wire of the latter is connected to earth, C, and also to the line wire D as shown. Fig. 2 shows the arrangement for a telegraph line. The transmitters and relays in this case are placed in the circuit of the coarse wire of the induction coil, and the other connections are shown. This arrangement can also be applied to the electrophone patented by the inventor on the 7th August, 1880, No. 3231. The inventor also describes a modification of his invention, which has for its object the neutralisation of the effects of induction caused by the line wires in proximity to the wire by which signals are sent.

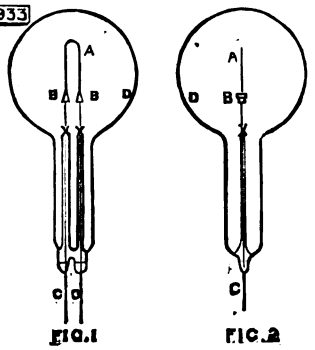
4515. IMPROVED CONSTRUCTION OF MOUTHPIECE LIP OR RIM FOR IMPARTING ELECTRIC CURRENTS TO FLUIDS WHILST PASSING INTO THE MOUTH, *J. Dunbar and R. R. Harper.—Dated 4th November*, 1880. 2*d*.

The inventors employ one or more opposite or negative and positive metals in conjunction with an insulating medium in connection with the rims of drinking vessels, &c., whereby an electric current is caused in the liquid.

4933. IMPROVEMENTS IN ELECTRIC LAMPS AND THE MATERIALS EMPLOYED IN THEIR CONSTUCTION, *J. W. Swan.—Dated 27th November*, 1880. 6*d*.

This patent refers more especially to the material of which Mr. Swan makes his carbons He takes cotton thread (preferably crotchet), treats it with sulphuric acid according to the process of making vegetable parchment, washes with water, dries, and then carbonises. The drawings

4933

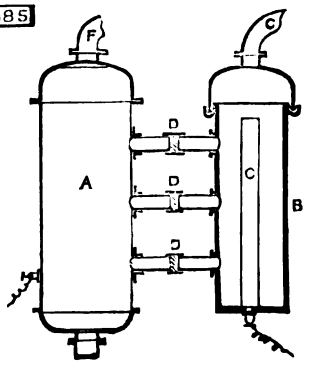


show the way in which the carbon is secured. A is the carbon, gripped by clips B B connected to the conductor C and surrounded by the glass globe D. The claims are (1) The method of obtaining the carbon; and (2) the thickening the ends of the carbon to obtain better contact, with a wrapping of cotton or other suitable material and treated as above.

4985. IMPROVEMENTS IN THE MANUFACTURE OF SODA, &c., BY ELECTROLYSIS, *T. Morgan.—Dated 30th November*, 1880.—(*A communication from N. Glouchoff.*) 6*d*.

This invention is an improvement on one provisionally patented on the 9th December, 1879, No. 5,030, by the present inventor and T. Wastchuk. The figure shows one form of the decomposing apparatus, which is in two parts. The carbon or platina C forms the positive electrode, and is contained in a glass cylinder, B, arranged at the side of the iron cylinder A, which forms the negative electrode. These cylinders are provided with lateral holes as shown, in which are

4985



inserted glass tubes connected together end to end in pairs by the india rubber collars D, care being taken to insert a thin partition of porous material in the collar between the ends of each pair of tubes. The hydrogen escapes through the pipe F, and the oxygen and chlorine through the pipe G. These gases are collected in reservoirs, and are subsequently distributed to the receivers of the gas batteries. The current generated in these batteries is utilised in turn to decompose a soda lye and manufacture soda by electrolysis.

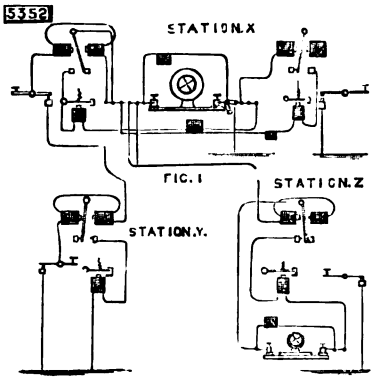
4961. IMPROVEMENTS ON MECHANICAL CONTRIVANCES FOR ELECTRO-MAGNETIC CLOCKS AND APPARATUS, *J. Mayr.—Dated 29th November*, 1880.—(*Not proceeded with.*) 2*d*.

This invention consists in mechanical improvements by means of which the inventor constructs a new system of electric clocks and signalling apparatus, and replaces the usual sliding spring and mercury contact by reliable metallic contacts with impact motion and exactly controllable duration.

5352. IMPROVEMENTS IN DYNAMO-ELECTRIC TELEGRAPHY, *S. Pitt.—Dated 21st December*, 1880.—(*A communication from Dr. O. Lugo*). 8*d*.

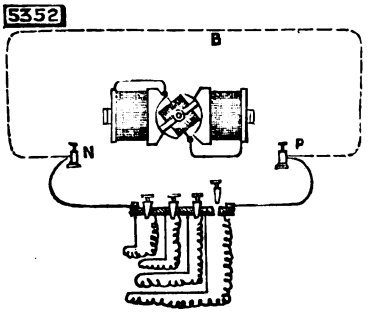
This invention has for its object the use of dynamo-electric machines in telegraphy. The inventor arranges his apparatus to obtain uniform currents, to vary the E.M.F. as required, to get

5352



multiplex working, &c. This arrangement, which may be modified in various ways, will easily be understood from Fig. 1. The dynamo-machine Fig. 2 is so made that the armature may be revolved till the poles P N are connected, as shown by dotted lines B. No current is excited in coils,

5352



but when so connected a weak current is excited in coils of armature, passes through the field magnets, reacts on armature, and so on till the maximum and constant current is obtained. If circuit B is broken, the field magnets and armatures are discharged.

IMPORTANT TO TELEGRAPH COMPANIES.

THE SANITAS COMPANY (Limited), of Bethnal Green, E., have received the following gratifying letters upon the subject of Sanitas and its uses at Foreign Telegraph Stations:—

"THE MANAGING DIRECTOR, THE SANITAS COMPANY (LIMITED). "February 4th, 1880.
"We have now for more than a year been using your SANITAS soap and disinfectants in our ships, as well as at our stations, and find it greatly approciated, more especially at tropical places, where the importance of sanitary arrangements is not well understood."
"London, 15th November, 1880.
"I think it right to inform you that our Superintendent at Mozambique says:—'I use the much-prized "SANITAS" freely, and feel perfectly safe wherever I sprinkle it.'
"JAMES ANDERSON, Managing Director, Eastern Telegraph Company (Limited), 66, Old Broad-street, E.C."

"SANITAS" DISINFECTING FLUID, No. 1, in 1/- and 2/6 bottles.
"SANITAS" DISINFECTING FLUID, No. 2, in 1/- pints.
"SANITAS" DISINFECTING OIL, @ 30/- per gallon.
"SANITAS" TOILET FLUID, in 1/- and 2/6 bottles.
"SANITAS" DISINFECTING POWDER, in 1/- boxes, and 17/6 per cwt.
"SANITAS" TOILET and NURSERY POWDER, in 1/- boxes.
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"SANITAS" DISINFECTING HARD SOAP, No. 1, in 6d. bars.
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"SANITAS" SOFT SOAP, in 1/-, 1/9, 3/-, 5/-, 9/-, 12/6, and 24/- sizes.
"SANITAS" TOILET SOAP. in 1/6 boxes of three tablets.
"SANITAS" DISINFECTING FURNITURE CREAM, in 1/- bottles.
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SANITAS is Non-Poisonous and Without Stain, and is used by 400 Public Bodies.

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ADDRESSES.

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Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

ELECTRIC LIGHTING.

THE

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION

(LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates, and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation is also prepared to receive applications for licences, or for concessions for defined districts, and to enter into negotiations with responsible parties for the sale of licences for the British Colonies. The superiority of the Brush system in economy and simplicity being thoroughly established, its rapid development is now assured.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

INTERNATIONAL MEDICAL and SANITARY EXHIBITION.

OPENING CEREMONY, ROYAL ALBERT HALL, SATURDAY, July 16th.

The President, the Right Hon. EARL SPENCER, K.G., will take the Chair at 4:30 p.m., supported by the Right Hon. Earl Granville, K.G.; the Right Hon. G. Dodson, M.P.; Sir James Paget, Bart., F.R.S.; and John Eric Erichsen, Esq., F.R.S.

Admission: Opening Day, by Season Ticket, Five Shillings; after Opening Day, One Shilling. From 10 till 7.

MARK H. JUDGE, Secretary.

All communications to be addressed, South Kensington, London W.

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LOUD AND CLEAR. NO JARRING.
PERMANENT ADJUSTMENT.
NO OXIDATION. ONE LOCAL CELL.

TASKER, SONS & CO.,
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138, LONDON WALL, WOOD ST., E.C.

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Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

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TELEGRAPH AND ELECTRICAL ENGINEER,
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Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.

Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.

NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

A Pamphlet, with full particulars, on application.

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THE "JAMIN" PATENT ELECTRIC LIGHT,
COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

FERD. CAPITAINE, Civil Engineer, 178, BOULEVARD VOLTAIRE, Paris.

Special attention given to every branch of applied electricity. Patents of Inventions applied for and worked on the Continent. Companies formed. Representation at Exhibitions. Commission Agent.

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EDISON AND THE EXHIBITION.—Amongst the first apparatus to arrive were the machines, &c., of Edison.

THE NEW AMERICAN CABLE.—The completion of the new cable between Lands End and America is announced.

TELEPHONY IN NEW YORK.—The number of messages per day sent by telephone in New York amounts to between five and six thousand.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this Company for the week ended the 8th July amounted to £2,883.

THE TELEGRAPH LINE IN AMERICA.—The *Operator* says that a contract has been entered into to build a new line from Philadelphia to Pittsburg.

ELECTRIC LIGHT AT TURIN.—Messrs. Baratti and Milano, confectioners of Turin, have lit up their "galerie subalpine" by Siemens lamps, worked by an Otto motor.

THE BRUSH COMPANY.—The Brush Electric Light Company of Baltimore, U.S.A., has been formed. Several hotels and manufacturers, &c., have adopted the light.

THE ELECTRIC LIGHT AND AERONAUTS.—At the Exhibition the Académic d'Aerostation will conduct ascents by night, in which lighting by electricity will form a prominent feature.

THE JABLOCHKOFF LIGHT AT HAVRE.—The Société Générale d'Electricité have obtained the contract to light the outer harbour of Havre for ten years on the Jablochkoff system.

CANADIAN GOVERNMENT AND THE TELEGRAPHS.—News from New York says that the report that the Canadian Government intends to assume the control of the telegraph lines is denied.

NEW FORM OF ELECTRIC LAMP.—M. Eugène Alliot, of Chateau-Renault, in the Department of Indre-et-Loire, France, has made an electric lamp in which the lower carbon is impelled by a liquid.

THE FAURE SECONDARY BATTERY.—Dr. Buchanan, of Glasgow, has published the account of his surgical operations (*The Electrician*, vol. vii., p. 57), in which this battery was used, in pamphlet form.

AN ELECTRIC MOTOR.—Mr. A. H. Doane, of Cincinnati, claims to have invented an electric motor which he can attach to a street car at an expense of 50 dollars and then run the car for 10 cents a day.

ELECTRIC LIGHT IN PARIS.—The lustre of the electric light contributed to the illumination of the Horticultural Exhibition held lately in the Champs Elysées by the National and Central Horticultural Society of France.

FORMATION OF AN OBSERVATORY AT BORDEAUX.—An observatory has been established at Bordeaux by the Chamber of Commerce. It is destined to record observations in astronomy, meteorology, and terrestrial magnetism.

INDIAN TELEGRAPH TARIFFS.—It is reported that some important changes in the telegraph tariff for inland messages are to be made. The charge for each word beyond the established minimum of one rupee for six words is to be two annas a word.

TELEGRAPH EXTENSIONS IN ARABIA.—The Turkish Government is about to connect Hodeïda and Jeddah to the submarine cable passing by Kurrachee and Bab-el-Mandeb to Suez. Meccha and Jeddah are also to be connected by telegraph.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this Company for the week ended the 8th July amounted to £1,962, after deducting the fifth of the gross receipts payable to the London, Platino, Brazilian Telegraph Company.

TELEGRAPH EXTENSIONS IN CEYLON.—Considerable extensions of the telegraph system are in progress, and it is hoped that the tariff now in force will be largely reduced when they are completed. The line between Colombo and Kandy is to be duplicated.

A SUGGESTION.—The *Operator* suggests to its readers in America that exhibitors at the forthcoming Exibition in Paris should have lucid descriptions of their wares printed in English, German, and French. The same advice may be handed on to English exhibitors.

ELECTRIC LIGHT ON SHIPBOARD.—We hear that the "Polyphemus," torpedo ram, recently launched at Chatham, is to be lighted by means of the "Brush" system of electric illumination. The cost of the necessary machinery and apparatus is put at about £2,000.

TELEGRAPH WIRE WANTED.—Tenders are invited to supply 40 tons of galvanised telegraph wire. Particulars can be obtained from Den General Direktion des Post und Telegraph Wesens, Bucharest, Roumania, where tenders will be received up to the 29th instant.

NEW YORK STREET LIGHTING.—As in London a short time since, so in New York the electric lights will go out occasionally. Those on Broadway were recently extinguished during a storm, and it was several hours before they were brought into working order again.

THE CHINESE AND THE TELEGRAPH.—It is stated that a class of Chinese students have been receiving instruction in telegraphy at Hartford, Connecticut, U.S.A.; and that the best amongst them will soon be sent off to China, to help to work the new line being erected there, we suppose.

THE COMET.—The first observer of the comet that has lately visited us, and is still to be seen, was, we believe, Mr. Newall, of Gateshead, the well-known maker of lightning conductors and cables. Mr. Newall has a small observatory of his own at his works at Gateshead, near Newcastle-on-Tyne.

TESTING LIGHTNING CONDUCTORS.—We are glad to learn that the Board of Guardians of Barrow-in-Furness have appointed Messrs. Norman and Son to report upon the lightning conductors fixed upon the workhouse, and, further, to make periodical inspections of the same. Surely this gives signs of improvement.

FRENCH PATENTS AND THE EXHIBITION.—During the exhibition inventors may exhibit apparatus similar to that described in their specification without invalidating their patent. Foreigners also may introduce similar apparatus into France to that for which they have applied for protection in the French patent office.

INDIA RUBBER, GUTTA PERCHA, &C., COMPANY.—The half-yearly meeting of this Company will be held at the Cannon-street Hotel on the 21st inst., at 12 noon, to receive the report of the directors. An interim dividend of 10s. per share, free of income-tax, will be declared, being at the rate of 10 per cent. per annum, payable on the 22nd instant.

PRICES.—The prices as quoted are:—For gutta percha, per lb., genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d.; india rubber, fine Para, 3s. 6½d. to 3s. 6¾d.; negro-head, 2s. 3½d.; central American, 1s. 11d. to 2s. 5d.; Assam and Pegu, 1s. 3d. to 2s. 1d.; other East Indian, 1s. 9d. to 2s. 4d.; Madagascar and Mozambique, 1s. 6d. to 2s. 4d.

SS. "JOHN PENDER."—This vessel (belonging to the Eastern

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Telegraph Company) had a very rough passage the other day from Bombay to Aden, time occupied in getting from the one port to the other being sixteen days. Several of the crew were injured. The vessel was caught in a cyclone that has caused considerable damage to shipping in the Indian Ocean.

West India and Panama Telegraph Company.—The estimated traffic receipts of this company for the half month ended June 15 amounted to £2,650, as compared with £1,833 in the corresponding period of 1880. The estimated receipts for the half month ended June 30 amounted to £2,093, as compared with £2,164 in the corresponding period of 1880.

Belgium and the Exhibition.—*L'Electricité* says that the number of Belgian exhibitors will be over one hundred. The commission which has been appointed by the Government will draw up a catalogue of the Belgian section, which will be edited by M. Bonneux, chief engineer of telegraphs, and will contain a preface treating of the progress of electrical science and industry in Belgium.

Quick Work.—The result of the Derby was transmitted to New York in wonderfully quick time. The following are the times of receipt and despatch of the message announcing the victory of Iroquois to the New York *Telegram*:—"Horses got away at 10:21:5, New York time. Iroquois passed winning post 10:23:55, New York time. Result reached New York 10:24. Time occupied in transmission, 5 seconds.',

The Direct United States Cable Company.—The Directors of this Company have resolved to recommend a final dividend of 5s. per share (free of income-tax), such dividend to be payable on and after the 16th August, making, with the interim dividends already paid, 5 per cent. for the year ending 30th June last, carrying forward £7,179 10s. 8d., after having carried to the reserve fund £32,292 9s., making it up to £235,000.

Electric Light for Southwark.—At the last meeting of the St. Saviour's Board of Works letters were received from the Electric Light and Power Generator Company and the Brush Company. The first company offered to light the main roads of the district at 2d. per hour, with a cost of £907 for plant. The Brush Company asked for time to provide a large lighting station. The letters were referred to the Paving Committee.

Mr. Macliver and the Telegraphists.—After the Land Bill has been disposed of we hear that Mr. Stewart Macliver, M.P., intends to move as follows in the House of Commons:—"That it be a recommendation to the Postmaster-General to reconsider and adjust his scheme for dealing with the telegraph clerks in accordance with the suggestions made to him, and that in any change the claims set forth by the letter-carriers should be recognised."

Electric Light and the Suez Canal.—*La Lumière Electrique* says that a project is on foot for lighting the Suez Canal by means of electricity, so that ships may pass up and down by night as well as day. This certainly sounds well, if it is feasible. The only question would be, would the Arabs and other pilferers leave the wires alone when the lights were installed. As a rule, we believe, the Commandments are not strictly observed in that quarter.

Abnormal Traffic.—During the visit of the President of the French Republic to Cahors, no less than 170,000 words were telegraphed during five days to the Press in different parts, the receipts amounting to more than 9,000 francs. At ordinary times the receipts for the same period would be but 200 francs at the most. The usual staff consists of young clerks who can only work the Morse instrument; on this occasion, however, experienced clerks had to be fetched from Paris and elsewhere, and Hughes's printing instruments were brought into use.

The Torpedo Accident at Melbourne.—The board appointed to inquire into the recent fatal torpedo explosion at Melbourne has reported that the Naval Torpedo Corps did not evince adequate skill and judgment in carrying out the operations, and that a want of training and practical knowledge was apparent. The board censured both Captain Mandeville and Lieutenant Collins for having left the "Cerberus" whilst the large torpedo was being submerged. They were unanimously of opinion that the disaster was occasioned by an electric current, but how the current had arisen was not quite clear.

Electric Light and Photography.—The part played by the electric light in the studio of the photographer is nowadays by no means unimportant. Not long ago we described its use in a large photographers studio in London. The Stereoscopic Society make great use of it, we believe, and find it a great aid to the successful defining of features. In America the other day it was used in a theatre at Cowbridge to aid in photographing certain scenes from "Œdipus Tyrannus," which had been played there. An electric lamp, said to be of 6,000 candle-power, was used, and found to succeed very well.

The Iron and Zinc Battery of Dr. Velsmann.—An endeavour has been made in Germany to replace the carbon in the Bunsen cell by cast iron. In this couple, the iron plunged in concentrated azotic acid at first assumes a passive state; after a certain time, however, the concentration of the liquid diminishes, and the iron dissolves with effervescence, and the cell has to be unmounted at once. Dr. Velsmann, however, has found a means for remedying this by adding silicium. He thus obtains a metal which remains inactive, and the E.M.F. of the battery is not diminished. The addition of silicium permits also of more azotic acid being used.

Electrical Patents in America. — The *Scientific American* says:—About 175 patents have so far been granted for patents relating to electrical lighting, in this country, and about three hundred more applications for patents thereon are now pending. When we consider the large number of patents now existing for telegraphing instruments, telephones, alarms, electrical batteries, switches, and the divisions of electrical devices, it will readily be understood that the Patent Office at Washington is rapidly becoming a great store house of novelties relating to electricity, and that this branch of invention is already one of extraordinary magnitude.

Cuba Submarine Telegraph Company.—According to the report of this company for the half year ending June 30 last, the gross receipts, including the balance brought from last account, amount to £18,503 9s. 1d., and the gross expenditure to £5,714 6s. 2d., leaving £12,789 2s. 11d. to the credit of revenue account. Of this £3,750 11s. 9d. has been placed to the reserve account, increasing it to £40,000. After providing for the preference dividend, a balance of £6,038 11s. 2d. remains, out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 7 per cent. per annum, leaving £438 11s. 2d. to be carried forward.

The London Telegraphists.—It would appear that the agitation among the aggrieved telegraphists, so far as the metropolis is concerned, has subsided. The officer whose

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name so often appeared as the leader of the movement, resigned that position some little time ago, with the result that the committee acting with him broke up. An attempt to form a fresh committee has, we believe, entirely failed. We sincerely trust that this may be interpreted as meaning that the claims of the London staff have been satisfied, or that there is trustworthy assurance that they will be satisfied in due time. There is some talk, however, of another meeting of delegates to-morrow, Sunday.

New Companies.—From America we hear of the incorporation of the following companies:—The Postal Telegraph Company was incorporated at Albany on the 21st June, 1881, and is to continue till 1981. It is to have wires in all parts of the United States, and has power to form telegraphic communication with foreign countries. The capital is three million dollars, with power to increase it to twenty-one million. A company has been incorporated to work Professor House's automatic printing telegraph. A line is to be constructed shortly between New York and Philadelphia. The Graphic Telegraph Company is shortly to make its appearance with a capital of five million dollars.

Anglo-American Cable Repaired.—The Brest St. Pierre cable, laid in 1869, which was broken on the 12th November last, has been picked up in 1,700 fathoms of water, and repaired by the Telegraph Construction and Maintenance Company with their ss. "Scotia," under the superintendence of Mr. F. R. Lucas, engineer to that company, and Mr. H. C. Forde, acting as engineer upon behalf of the Anglo-American Company. Telegraphic communication between France and the United States of America by this company's cable, *viâ* Brest, has, therefore, been restored. The company has now four Atlantic cables at work, *viâ* Valentia and *viâ* Brest, and their system throughout is in good working order and condition.

Telegraph Wires and Poles.—The Attorney-General, replying in the House of Commons on Monday last to Mr. W. H. Smith, said the erection of telegraph wires and poles was regulated by Acts passed in the years 1863, 1868, and 1878. The first of these measures gave power to the telegraph companies to make such erections with the consent of the local authorities, and the Act of 1868 transferred the powers vested in the telegraph companies to the Post Office. By the Act of 1878, if any question arose between the Postmaster-General and the local authority with respect to these matters it was to be settled by the arbitration of a magistrate. The local authority was thus *primâ facie* entrusted with the safety of the public.

Telephonic Facilities.—With the object of increasing present facilities, the United Telephone Company has just concluded an arrangement with the Postmaster-General, under which three of the company's principal exchanges will be at once connected by the telephone with the Telegraph Department at St. Martin's-le-Grand. Each subscriber to the company's exchanges will thus be placed in immediate and direct communication with the Post Office, and will be able to arrange with that department to transmit messages through the telephone direct to the Central Telegraph Office, whence they will be delivered by hand within a short radius of St. Martin's-le-Grand, or forwarded by telegraph to other parts of London or the United Kingdom.

Telegraphists in Ireland.—Mr. Fawcett, replying in the House of Commons to Mr. Sullivan, said:—Telegraphists who have been appointed subsequent to the transfer of the telegraphs to the State are not eligible for appointment to vacancies in the Accountant's Department, Ireland, because the standard of examination for that office is higher than that prescribed for telegraphists. The standard of examination had not been prescribed at the time of the transfer, and it was held that the transferred telegraphists were eligible for appointment to any office to which clerks at that time in the service could be appointed under the regulations then in force. The Department of the Accountant of the Post Office in Ireland was one of those offices.

Honouring the Dead.—In France the same system of putting up tablets on the houses where great men have lived as is pursued by our own Society of Arts would appear to exist. *La Lumière Electrique* says that recently a tablet was placed on the house where where Jacques de Romas lived and died, at Nérac, the inscription on which runs as follows:—"To Jacques de Romas, member of the Royal Academy of Sciences of Bordeaux, corresponding member of that of Paris, &c., inventor of the electric kite, born at Nérac the 15th October, 1713, died at Nérac the 21st January, 1776. To the forerunner and rival of Franklin this commemorative tablet has been erected on the house where he lived and died, by the loving care of his relative, the Baron de Frère de Peyrecave, 1st June, 1881."

Observance of Sunday at the Exhibition.—A communication has been forwarded to the Postmaster-General from the Lord's Day Observance Society, stating that at the Paris Exhibition of 1878, and at other previous exhibitions, English exhibitors had agreed to dispense with the services of their attendants on the Sunday. The Society appeals to the Postmaster-General to set the example at the approaching electrical exhibition by dispensing with the services of the attendants of the Post Office section of exhibits and to use his influence with British exhibitors generally to do the same. To this appeal the Postmaster-General has replied that he is ready to adopt the suggestions of the Society so far as the Post Office is concerned, and that its attendants' services will not be required on Sundays.

Legal.—Judgment in the case of "Williams *v.* the Western Union Telegraph Company and others" has been given. The suit was brought to restrain the proposed increase of the Western Union Company's stock. Judge Truax has given his decision in favour of Jay Gould, and against Williams. He finds that Jay Gould, Russell Sage, and Thomas T. Eckert did not enter into an unlawful combination or agreement with others for the purpose of uniting large amounts of capital and depressing the stocks of the several telegraph companies in order that they might get control of them. In the case of "Hach *v.* the Western Union Company"—a case similar to the above—judgment has been given against the plaintiff. Notices of appeal have been given against both these decisions.

Electric Light in Ironworks.—In consequence of the additional output of steel at the Rhymney Ironworks in Wales, it has been found necessary to increase the working power of the rail banks; and to avoid laying down an extra number of machines, the bank has been lit up by electric light, so as to enable rail straightening, &c., to be continued during the night as well as by day. The Brush system is employed. The circuit comprises 1,540 yards of cable, sixteen lamps, and a dynamo-machine, which is worked by a pair of Tangye's engines, 9in. cylinders, 18in. stroke, developing 16 horse-power. The machinery stands in a neat building adjoining the fitting shop, and provision has been made for a second machine. The light was first used on the 2nd of June with perfect success. The roll turners' erecting shops and the foundry have been also lighted by this means.

The Higgs and Edison Electric Lamps.—It is re-

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ported from New York that a trial of the respective systems of electric lighting invented by Dr. Higgs and Mr. Edison will be made to test their merits as illuminators. Dr. Higgs's lamp, as we stated in the description of it given in our issue of the 11th of June, is on what he calls the infinitesimal arc system—that is, the distance between the two poles of the lamp is so minute as to be scarcely perceptible to the eye. Owing to this arrangement the least possible resistance is offered that is compatible with the generation of a high temperature and the formation of a brilliant light. Dr. Higgs is stated to have run a 40-candle lamp with from six to eight Bunsen cells, whilst the energy absorbed by one of Edison's eight-candle lamps is put at 40 Bunsen cells. The results of this trial of the two systems, if it comes off, will be interesting.

Electric Lighting at Barrow.—The ss. "City of Rome," launched on 14th June (and now being rapidly pushed forward, work being carried on night and day), has been lighted up with ten lights inside, viz., four in the engine room, which is about forty feet square, and six other lights in the boiler spaces. The system used is the Brush, the Barrow Shipbuilding Company having four of the Brush sixteen-light machines in regular use. One of these machines has been turned to account for the present to supply the lights for the "City of Rome," as well as seven lights to illuminate the approaches to the ship and the yard adjoining. The arrangements for the above have been carried out by Messrs. Norman and Son, engineers, electricians, and contractors of this town, and execution of the work has given every satisfaction to the Shipbuilding Company's officials. The light is also much in favour amongst the workmen.

Electric Light in New York.—Further details of the high lights in course of erection in Union and Madison-squares, and also in Central Park, New York, by the Brush Company, say that each of the poles is to be 165 feet long, fifteen feet of it being placed in the ground, thus making the total height above ground 150 feet. They are made of boiler iron, and are four feet in diameter. At a certain distance from the ground a sort of balcony will be constructed, somewhat similar, we suppose, to the Siemens high standards, which will be used to lower the lamps on to, for cleaning, putting in new carbons, &c. Each pole is to be supported by guy ropes attached to posts firmly stuck in the ground at a distance of 75 feet from the pole. Lamps of 24,000 candle-power are to be placed at the top, and lower down lights of 12,000 candles or a total of 36,000 candles. This experiment should throw some light not only on the streets and squares of New York, but on the question of one or two high lights of great power, as compared with several smaller lights nearer the ground.

The Telegraph Clerks.—At a meeting of Liverpool telegraph clerks held on Saturday evening last, a senior clerk presiding, the following resolutions were discussed and carried unanimously:—1. "That this meeting expresses its dissatisfaction with the plan of revision proposed by the Postmaster-General as a remedy for the grievances complained of by the clerks of the Telegraph Department, and its surprise that after the facts placed by them before the authorities and the popular support which their claims have received, a scheme should be applied to them conferring so little financial benefit. 2. That this meeting expresses its deep astonishment that a member of the present Administration has, by a threat of withholding from the telegraph clerks concessions which justice demands, sought to prevent those clerks from using their constitutional rights." After the transaction of some formal business relative to the forthcoming national conference, the meeting which had been very enthusiastic throughout, terminated. Similar meetings have been held at Leeds and other places.

Infringement of the Bell Patent.—Judgment has been given at Boston in the United States Circuit Court in the case of "American Bell Telephone Company and others *v.* Albert Spencer and others." This was a case of alleged infringement of two patents granted to Alexander Graham Bell. The defendants admitted that they had infringed some valid claims of the second patent, but the plaintiffs had given them no evidence of such infringement. They relied entirely upon the fourth claim of the first patent, which is much more comprehensive in its scope. This claim was that the defendants were using a method and apparatus for transmitting vocal sounds which resembled those of the plaintiff in producing electrical undulations, copied from the vibrations of a diaphragm, and sending them along a wire to a similar receiver at the other end. The Court decided that the specific method of producing the electrical undulations was different. It was made on the principle of the microphone, which had been very much improved since the date of the first Bell patent. The judge said:—"If the Bell patents were for a mere arrangement or combination of old devices to produce a somewhat better result in a known art, then, no doubt, a person who substituted a new element not known at the date of the patent might escape the charge of infringement. But Bell discovered a new art, that of transmitting speech by electricity, and has a right to hold the broadest claim for it which can be permitted in any case—not to the abstract right of sending sounds by telegraph without any regard to means but to all means and processes which he has both invented and claimed."

The Late Thunderstorm.—The town of Barrow-in-Furness was visited by the storm about 4:30 p.m., when it raged for nearly half an hour. All was quiet until near eight p.m., when the storm appeared to work round again from the north-east, by the south, round to the west, gradually increasing in violence until about 8:30 p.m., when the grandeur of the spectacle was seen to the best advantage, and with an intensity never equalled in the memory of the oldest inhabitant. About this time a house at the corner of Brighton and Settle-street was struck, and the roof very much damaged. The westerly wind appears to have blown the heated air from the kitchen chimneys towards the east, and from this direction the discharge appears to have taken place. Entering the chimney, it has descended about four feet, just to the level of the ridge of the roof. At this point it was discharged through the chimney, throwing the bricks over the whole roof, and stripped the slates off from the ridge to the gutter on both sides. The down rain pipe running well into the ground carried off the discharge without further damage. Several people in the house at the time escaped uninjured. A correspondent informs us that "at No. 10, Drake-street, the lightning following the same direction as I have described above, and also passing down the rain pipes to earth. In both these instances no trace of the lightning is visible after the rain pipes have been reached. At the height of the storm the conductor on the top of my house was seen to be struck repeatedly, but inside we were quite ignorant of the fact until told by those who had seen it from the outside. I have examined the top of the rod and it shows the marks plainly. The storm raged without abating until nearly 10 p.m., but the thunder could be heard and lightning seen until after midnight. All the telegraph instruments on the Furness Railway were demagnetised, but as protectors were fitted to them the coils have escaped uninjured."

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ON AN ELECTRO-DYNAMIC BALANCE.*

By H. Helmholtz, For. Mem. R.S., Professor of Physics in the University of Berlin.

In order to avoid the disturbances produced by the variations of direction and intensity of terrestrial magnetism in measuring the intensity of galvanic currents by their electro-magnetic effects, I have tried to construct an electro-dynamic balance. I have suspended at the ends of the lever of a smaller chemical balance, instead of the scales, two coils of copper wire, their height being equal to the diameter of the cylinder around which the wire is coiled up. Their axis is vertical, and they are suspended in such a manner that they cannot turn around this axis. Two larger spirals of the same height, but of greater radius, are placed into a fixed position, borne by a horizontal metallic rod, the middle of which is fixed on the column bearing the balance. The connections of the wires are arranged in such a way that one of the movable coils is attracted by the fixed coil, the other is repelled. Both the fixed coils are placed a little higher than the movable coils. The attracted coil rises, the other sinks down as soon as a current passes through the circuit.

There are two difficulties to be overcome in the construction of such a balance. At first, the current must be introduced into the movable spirals without diminishing their mobility, and without introducing places of contact of too small a pressure, which would make the resistance variable. I have succeeded to do this in a very satisfactory manner by using a kind of very thin sheet-brass, used for playthings of children, called in German "Rauschgold" (tinsel), because it looks like gold, and makes a crackling noise when it is moved. Strips of this, about 30 centims. long and 6 or 7 millims. broad, are very flexible, and show no signs of internal friction, their resistance to electric currents is very moderate, and they are not easily heated even by strong currents, because they have a relatively large surface in contact with air. I have connected each of the movable spirals with the other wires conducting the current by two such strips hanging loosely down from four pieces of brass fixed at the upper parts of the case of the balance. I may be allowed to remark that strips of the same kind, and of greater length, are very useful to demonstrate the action of a magnet on a movable current. If you suspend the strip so that it hangs down in a curve, it is attracted, repelled, even raised against gravity, or coiled up around the magnet with great rapidity, in a very striking way.

The second difficulty is to bring the coils into such a position that neither the stability nor the sensibility of the balance is impaired. In order to do this, it is necessary that the intensity of the electro-dynamic force does not vary sensibly during the usual small oscillations of the balance. Now, the force is zero if the middle of the movable coil is at the same height as that of the fixed coil. The force is again zero if the distance of the two coils becomes infinite. Between those two zero points there exists a maximum value of the force, which corresponds nearly to that situation where the upper surface of one of the coils is at the same height as the under surface of the other. Between the central position of the two coils and this position of maximum force, therefore, the differential coefficient of the force related to increasing distance of the centres is positive, and turns into negative when we pass the position of the maximum. This differential coefficient becomes again zero at an infinite distance. Therefore, between the position of maximum force and infinite distance there must be a distance where the differential coefficient of the force has itself a negative maximum, and the second differential coefficient, therefore, is zero. This is the position which must be given to the coils. As always the distance of one pair of the coils is diminished as much as that of the other pair is increased, the variation of the force depends only on the second differential coefficient. If this is positive, the electric current produces unstable equilibrium; if it is negative, the stability of the equilibrium is increased; that is to say, the balance becomes less sensitive than it is without current. If the coils are brought into the right distance, neither the sensibility nor the stability of the balance is altered, and by this circumstance itself the right position can be found out.

If the instrument is well adjusted you can determine the weight which balances the electrodynamic force with errors not exceeding one milligramme. As the force exerted by the current is proportional to the square of its intensity, you determine the intensity of a current, which is counterbalanced by one gramme with an accuracy of $\frac{1}{2000}$, and the force which opposes the electrodynamic force and measures it is gravity alone, and, therefore, not subject to any variations, like those of terrestrial magnetism, or like the elasticity of a twisted wire on which one of the coils is suspended.

The observations of the electro-chemical equivalent of the current corresponding to one gramme of weight, performed by different observers during the course of last year, have given a very satisfactory agreement.

* *Proceedings of the Royal Society.*

ELECTRICITY AT THE ROYAL AGRICULTURAL SHOW AT DERBY.

(BY OUR SPECIAL CORRESPONDENT AT DERBY.)

It may be thought, and truly so, that few applications of electricity have been made in apparatus connected with agriculture. Still, it is now getting on for two years since a dynamo-electric machine was tried as a motor to actuate ploughs at Sermaize. So far as that experiment is concerned, there is no indication of its having made any deep impression by any apparatus to be seen at Derby.

The miscellaneous exhibits and those indirectly rather than those directly used for agricultural purposes indicate, perhaps, that the rubicon has been passed, and in years to come electrical appliances will be no unique things at these shows.

A large meed of praise will always be due to the Royal Agricultural Society from the pioneers of electric light enterprise, inasmuch as it has been under the auspices and incentive of this society that the portable and semi-portable engines so largely used for electric light purposes have been brought to the point of perfection they have obtained. All the eminent makers of these engines are represented at Derby, and it would be an invidious task to attempt to decide whose build of engine was the best where all are so excellent. There are engines by Clayton and Shuttleworth, by Hornsby and Sons, by Marshall, Sons, and Co., by Ransomes, Head, and Co., by Robey and Co., by Ruston, Proctor, and Co., and so on, any one of which may be depended upon for design and workmanship. The designs of the various makers differ in minor details, each of which are supposed to present something superior to that of rival makers; but it is well known that, taken as a whole, the engines run one another very closely in any competition in which they may be engaged. It may not be out of place here to say that Messrs. Ransomes are engaged on an engine specially designed for electric light purposes, and we believe that this engine will be shown at the Paris Exhibition.

Mr. Turner, of St. Albans, exhibits a gas engine, which has been successfully tried with the Swan lamp at Lord Salisbury's. This engine, with the expenditure of 1 h-p., kept alight 12 of Swan's lamps, but not at their full brilliancy. On reducing the lights to 8, however, the full effect was obtained.

We noticed that Messrs. Western and Co., of the Chaddiston Works, Derby, had two Siemens dynamo machines with which to drive some of the wood-working machinery exhibited. As we saw the arrangement, the driving machine was placed to drive a four-cutter moulding and planing machine, and we understood that the power obtained from the dynamo machine was from 4 to 5 h.-p. Messrs. Deakin, Parker, and Co., of Sandon Works, Salford, Lancaster, exhibit a specially designed 10 h.-p. stationary engine for electric light purposes. This engine is fitted with a modified Hartnell governor. It could not be shown in motion owing to an accident received during the transit by rail.

Thus we see that builders of engines are considering the special requirements of the electric light, and hence we may expect still further improvements in details. As usual, a telegraph office is open in the show yard.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice watever will be taken of anonymous communications.*

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THE ROYAL INSTITUTION.

It is fitting that we should record the anniversary meeting of the Royal Institution in this number, which contains the concluding portion of the Faraday lecture delivered this year by Professor Helmholtz. Faraday's name is inseparably connected with the Royal Institution. It was here he commenced, carried on, and concluded his historic labours. It was here he elaborated theories, founded upon experimental researches, that the late Professor Clerk Maxwell so ably developed mathematically.

We all know that a younger generation is springing up, which, although it acknowledges Faraday as a giant in electrical science, may not be so familiar with the other historical associations that cluster around the house in Albemarle-street. Benjamin Thompson, better known as Count Rumford, greatly assisted in the carrying out of a proposal to found the Royal Institution, he being elected secretary at an early meeting of the managers. According to his letters he put off a long-promised visit to America, in 1799, in order to give his assistance to the undertaking. In 1801 we find Count Rumford writing to his daughter from the Royal Institution. He says:—I am still established at the Institution. I have been exceedingly busy, but desire to be thankful that all is now nearly completed, when I shall be at liberty. We have found a nice, able man for this place as lecturer—Humphrey Davy. Lectures are given, frequented by crowds of the first people." The popularity of the Institution lectures has certainly not decreased during the eighty years that have intervened since Count Rumford wrote, for the lectures of the present Professor—Dr. Tyndall—are delivered to crowded audiences, which must be spoken of as "of the first people."

Having given Rumford the credit of founding the Royal Institution, we are bound to acknowledge that Humphrey Davy attended its infant steps, prevented its early death, and left it a robust youth, full of vigour and prosperity. But Davy was not the first lecturer. He succeeded Dr. Garnett, who had lectured for one season and part of another, when he resigned. Dr. Young was soon after made Professor of Natural Philosophy. In his work on the Royal Institution, Dr. Bence Jones, writing of Davy's work in 1806, says:—"Volta sent the first account of his discovery of the voltaic pile to Sir Joseph Banks. His paper was printed in the *Philosophical Transactions* for 1800, on the 'Electricity Excited by the Mere Contact of Conducting Substances of Different Kinds.'" Davy wrote, in 1800, "Galvanism I have found by numerous experiments to be a process purely chemical." In 1806 he carried on his investigations, and these caused him to be "looked on as the discoverer of electro-chemistry." In 1807 he "proved that the bases of the alkalies were solid metals." He obtained potassium and sodium. These were the discoveries of the early years of the century. A little later came the experiments with the electric light, and an almost continuous series of original papers were sent to the Royal Society for many years by this indefatigable discoverer; but his electrical researches were destined to pale before those of his pupil, assistant, friend, and successor at the Royal Institution—the immortal Faraday. Professor Helmholtz, in the lecture we have previously referred to, has worthily spoken of Faraday's achievements, and we must all feel that the Royal Institution was, so to speak, consolidated and fashioned into a permanent institution by the labours of this great man. For a time, after Davy severed his more intimate connection with it, it languished; but the youth was too sturdy to receive much harm. The pre-eminent researches of Faraday made it the centre of scientific thought.

Faraday died. The Royal Institution lives and flourishes. It is now, perhaps, not so much the centre as a centre of scientific thought. Professor Tyndall is no mean exponent of scientific truths; indeed, we doubt if either Davy or Faraday were his equals as a lecturer.

The desires of the promoters so far as lectures and original research are concerned have been amply fulfilled, but in other directions the success attained has not been so great. It was proposed to "furnish a spacious repository with such machines, instruments, and utensils as, after sufficient experimental examination, can with confidence be recommended for introduction into common use;" also to publish "from time to time, in its *Journals*, such improvements as may either have been made by its means, or may have been otherwise suggested by individuals in foreign countries or in our own." In the early days of the Royal Institution more was done in the way of publications than at present, when the *Journal* is issued annually, and only contains abstracts of the Friday evening lectures, or, in many cases, the simple announcement "abstract deferred." This, we think, is a great blot upon the management of the Institution. These lectures are generally of great excellence, and to defer an abstract for more than twelve-months, is to defer it to a time when progress has taken away all interest in the lecture. We could also wish that

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the series of lectures delivered by the Professors were more frequently published by the Institution.

Such is the position of the Royal Institution. Born with the century, it has been favoured with a continuity of able and original thinkers whose works have during its life of four-score years given to it a reputation second to none, and we trust that there will be no retreat from the high position which it has taken.

THE CONGRESS OF ELECTRICIANS.

The following is a list of some of the members of the Congress of Electricians, to be held in connection with the approaching International Electrical Exhibition. The names are arranged according to the countries represented by the different members in alphabetical order:—

AUSTRO-HUNGARY:—
Baron Lorand Eötros.
Dr. Herman Militzer.

BELGIUM:—
M. Bonneux, Chief Engineer of Telegraphs.
M. Gérard.

BRAZIL:—M. Jamin.

FRANCE:—
The Minister of Posts and Telegraphs (President).
The Minister of Public Instruction, &c.
The Minister of Public Works,
The Minister of War,
} Vice Presidents.
M. Abria, of the Faculty of Sciences of Bordeaux.
M. Allard, Inspector-General of Roads and Bridges, Director-General of Lighthouse Service.
M. Baron, Director at the Ministry of Posts and Telegraphs.
M. Paul Bert, Professor at the Faculty of Sciences, Paris.
M. Rd. Becquerel, Member of the Institute, President of the Academy of Sciences.
M. Bergon, Director at the Ministry of Posts and Telegraphs.
M. Berthelot, Member of the Institute.
M. Berlin-Mourot, Sub-Director of the Normal School.
M. Brequet, Member of the Institute.
M. Blavier, Chief Engineer of Telegraphs, Director of the Higher Telegraph School.
M. Boussac, Chief Controlling Inspector at the Ministry of Posts and Telegraphs.
M. Bouty, Professor at the Saint-Louis Lyceum.
M. Collegnon, Civil Engineer, Inspector of the National Engineering School.
M. Cornu, Member of the Institute.
M. Daubrée, Member of the Institute, Inspector-General of Mines, Director of the National School of Mines.
M. Marcel Deprez, Electrician.
M. Desains, Member of the Institute.
M. J. B. Dumas, of the French Academy, Secretary of the Academy of Sciences.
M. le Comte du Moncel, Member of the Institute.
M. Durand-Claze, Civil Engineer.
M. Fizeau, Member of the Institute.
M. Fontaine, Engineer, President of the Syndical Chamber of Electricians.
M. le Général Frébault, Senator.
M. Garbe, Professor of General Physics and Meteorology at the Preparatory Science School at Alger.
M. Grova, Professor of Physics at the Faculty of Sciences of Montpellier.
M. Guillebot de Nerville, Inspector-General of Mines.
M. Jablochkoff, Electrical Engineer.
M. Jacqmin, Director of the Eastern Railway Company.
M. Jamin, Member of the Institute.
M. Joubert, General Secretary of the French Physical Society.
M. Jousselin, Principal Traffic Inspector of the Paris, Lyons, and Mediterranean Railways.

FRANCE (*continued*):—
M. Lalanne, Member of the Institute, Inspector-General of Roads and Bridges, Director of the National Engineering School.
M. Lartigue, Director of the Société Générale des Téléphones.
M. Leclère, Captain of Artillery.
M. Le Roux, Professor of Physics at the Higher School of Pharmacy.
M. Lesguillier, Deputy, Director of State Railways.
M. Maurice Lévy, Civil Engineer, Professor at the Collège de France.
M. Lippmann, of the Faculty of Sciences of Paris.
Colonel Margin, of the Engineers.
M. Hervé Mangon, Member of the Institute, Director of the Arts and Trades Conservatoire.
M. Marez, Member of the Institute, Professor at the Collège de France.
M. Mascart, Professor at the Collège de France, Director of the Central Meteorological Office.
M. Mathias, Chief Traffic Engineer of the Northern Railway.
M. Mathieu, Naval Captain.
M. Mercadier, Telegraph Engineer, Inspector of the Higher Telegraph School.
M. Mouton, of the Faculty of Sciences of Paris.
M. Negreneuf, of the Faculty of Sciences of Caen.
M. Gaston Planté, Electrician.
M. Potier, Professor at the School of Mines and the Polytechnic School.
M. Ragnaud, Telegraph Engineer.
M. Reboul, of the Faculty of Sciences of Marseilles.
M. Regnault, Honorary Chief Traffic Inspector of the Western Railway.
M. Richard, Engineer Director of Telegraphs.
M. Le Général Baron de Saint-Cyr-Nugues, President of the Military Telegraphs Commission.
M. Sebert, Lieut.-Colonel of Marine Artillery.
M. Sévène, Civil Engineer, Director of the Orleans Railway.
M. Terquem, Professor at the Faculty of Sciences of Lille.
M. Violle, Professor at the Faculty of Sciences of Lyons.
M. Wolf, Astronomer at the Paris Observatory.

NETHERLANDS:—
M. Van Kerkwick.
M. Boscha.
M. J. M. Colette.

PORTUGAL:—
Dr. Antonio dos Santas Viégas.

RUSSIA:—
M. Lenz.

SWEDEN AND NORWAY:—
M. C. A. Mystroem.
M. O. J. Broch.

SWITZERLAND:—
M. Timothée Rothen.

BRITISH ELECTRIC LIGHT COMPANY.—The third annual general meeting of this company was held on the 13th inst. at their offices in Heddon-street, Regent-street. Mr. Joseph Hubbock, J.P., chairman of the company, presided. The report of the directors showed that during the past year, ending the 30th April, after writing off a considerable amount of the preliminary expenses of the company, and paying an *interim* dividend at the rate of 5 per cent. per annum for the half year ending the 30th of April, 1880, a profit of £6,084 15s. 6d. had been made. In presenting the report to the meeting, the chairman congratulated the shareholders upon the favourable position of the company, and pointed out that their business was increasing in a very rapid manner. During the past year the company had acquired interests in several patents for improvements in electric lamps. The directors recommended a further distribution of 7½ per cent. for the past six months which, together with the 2½ per cent. paid on the previous half year, made a total dividend of 10 per cent. for the year, free of income-tax. The report and balance sheet were adopted, and the proposed dividend agreed to. A resolution was also passed, authorising the remainder (£60,000) of the capital to be issued at a premium of £1 per £10 share.

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THE BERLIN ELECTRIC RAILWAY.

In the accompanying drawings we illustrate the various apparatus used by Messrs. Siemens and Halske on the electric railway constructed by them, and now and for some time past in operation at Berlin. The general arrangements of the line are shown clearly in Figs. 1 to 8. In Fig. 4 is shown the mode of jointing the rails; in addition to the ordinary fish-plates light strips of iron are rivetted on the bottoms, passing from one rail to another, and forming an electrical connection. In Fig. 5 is shown the cross section at crossings, &c., in Figs. 6, 7, 8 the detail of the cross sections at the three stations, No. 2, 6, and 16. The horizontal steam engine, shown in Figs. 9 and 10, belongs to the pumping station for the Lichterfelde water supply, and is only used provisionally. The motor to be used permananently is a rotary steam engine of Dolgorouke's patent, as shown on page 139. It consists of a casting in the rings fastened on the axles, which are also insulated from them. Contact brushes press against these brass rings, and from them the current traversing the rails is conducted by means of the tires to the brass rings, collected by the contact brushes, and conducted to the dynamo-machine, which is put in motion and transmits its movement to the wheels as above explained. The rails are ordinary steel make, laid on wooden sleepers, the gauge being one metre. They are connected by short strips of iron, as described above. The currents are of low tension, and, therefore, no further insulation is necessary, no difficulty being experienced in using one rail as the positive, and the other as the negative conductor. The original line was about one and a-half mile long, and extended from Lichterfelde, a suburban station on the Berlin Anhalt Railway, to the Military Academy. Subsequently, however, the authorities gave

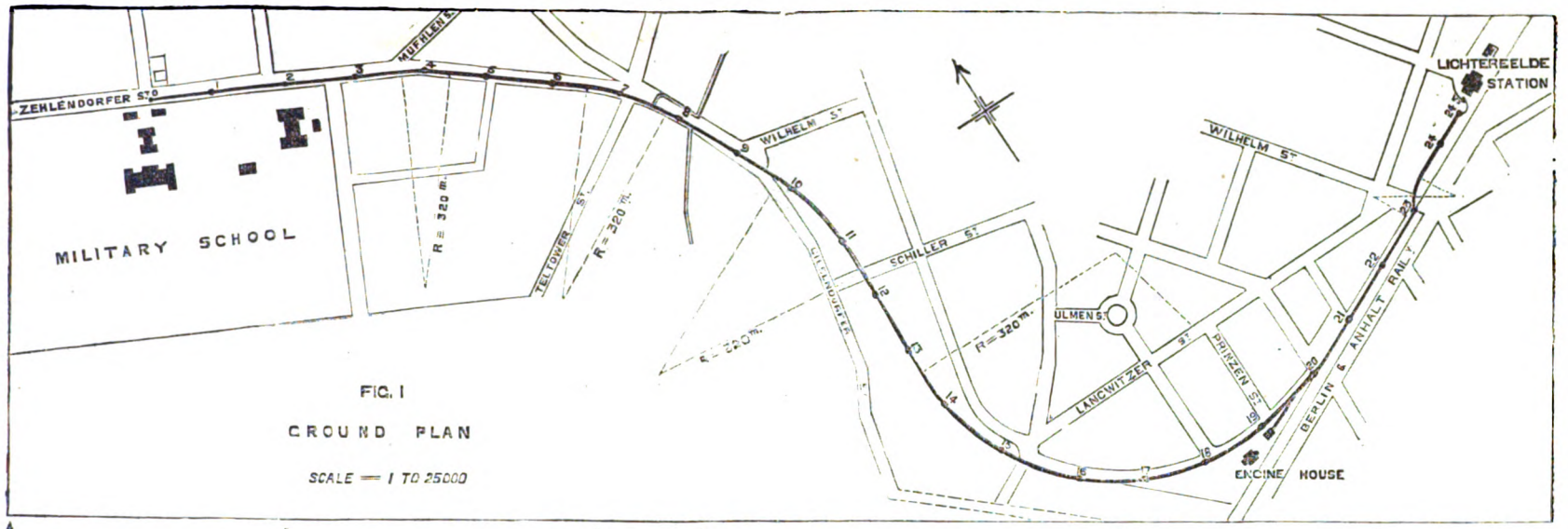
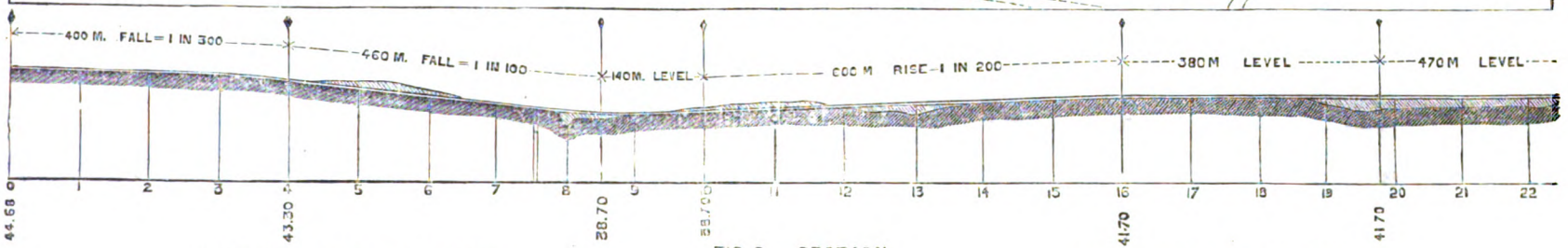


FIG. 1

GROUND PLAN

SCALE = 1 TO 25000



HORIZONTAL SCALE = 1 TO 100.000

FIG. 2 SECTION

VERTICAL SCALE = 1 TO 10.000

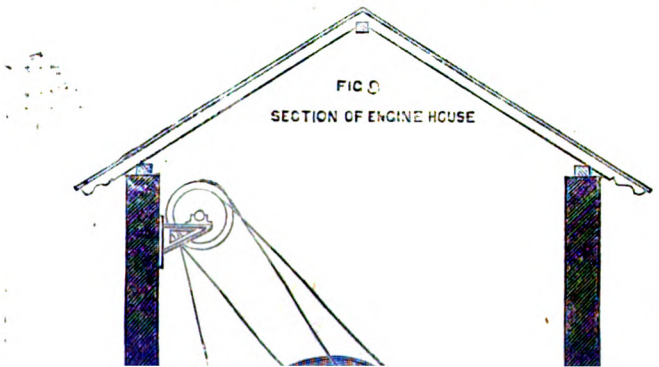


FIG. 9

SECTION OF ENGINE HOUSE

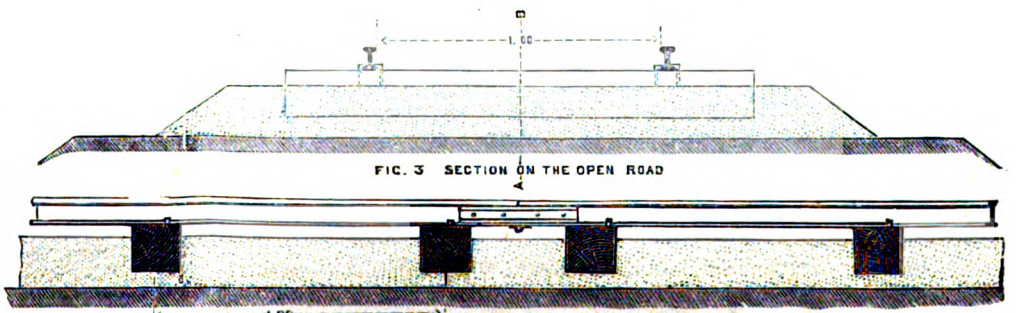


FIG. 3 SECTION ON THE OPEN ROAD

FIG. 4 LONGITUDINAL SECTION AT A. B.

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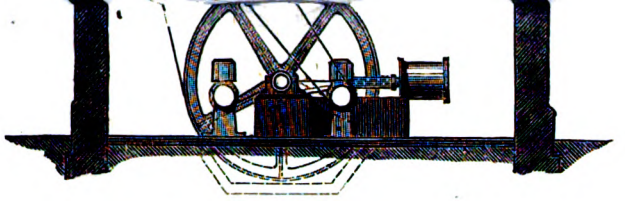


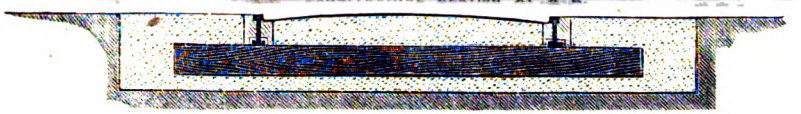


FIG. 5 SECTION AT CROSSINGS AND ON THE HORSE-ROAD

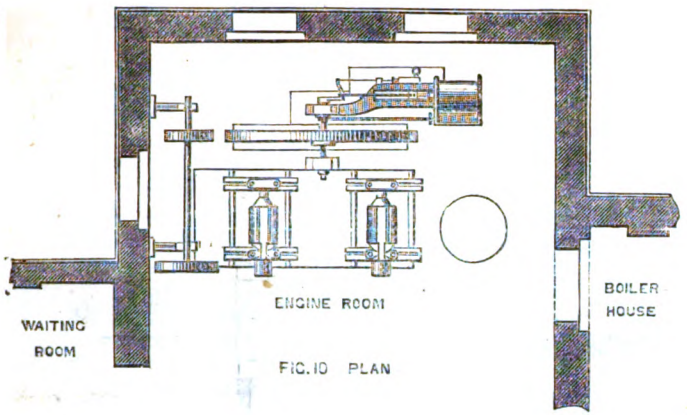


FIG. 10 PLAN

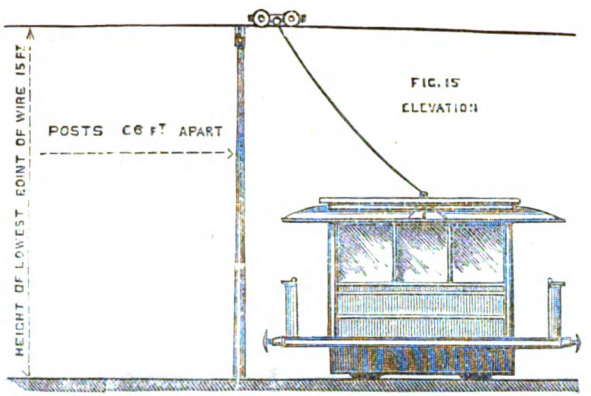


FIG. 15 ELEVATION

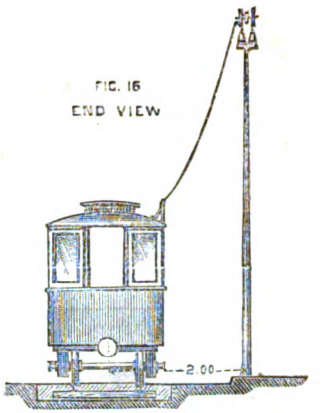


FIG. 16 END VIEW

VIEW OF INSULATED WIRE TRAMWAY

FIG. 6 CROSS SECTION, STATION 2

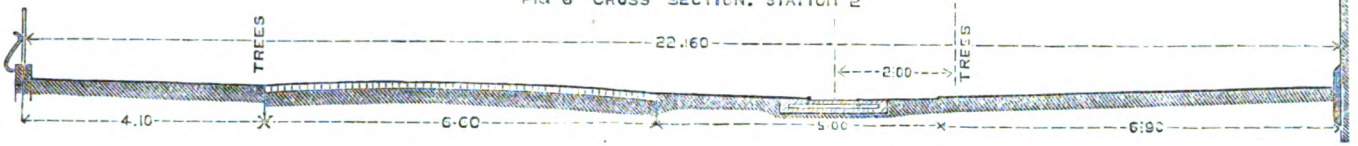


FIG. 7 CROSS SECTION- STATION 6

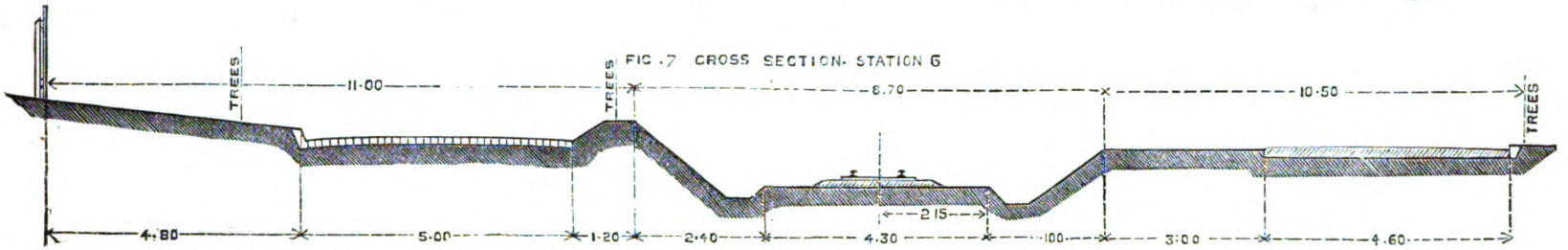
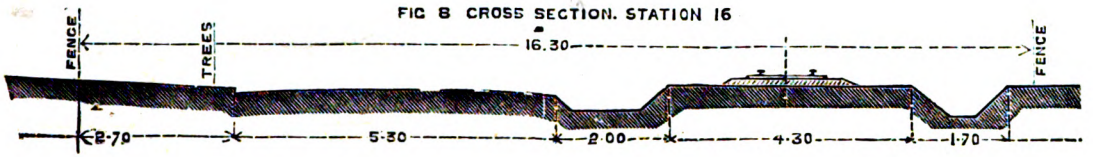


FIG 8 CROSS SECTION. STATION 16



form of a double cylinder, within which rotate two rotary pistons. Two such castings are placed end for end, so as to form a twin machine, with pistons at 180 deg. interval. By this means the balancing of the strains, which has always been a difficulty with rotary engines, is provided for. The parts are so arranged and so exactly fitted that no packed joints are needed. Figs. 13, 14, and 15 give different views of the car, which is exactly similar to the ordinary tramcar, and is constructed to hold twenty persons besides the conductor. It is symmetrical, and can move backwards or forwards, each end being provided with a starting lever for the use of the conductor, a brake handle, and a signal bell. The dynamo-machine is placed underneath the car, and transmits its movement to the wheels by means of spiral steel springs. The tires of the wheels are insulated from their axles, but are in electrical connection with brass

permission for Messrs. Siemens and Halske to extend it, first to Tetlow, and afterwards as far as Potsdam. The working of the line has gone on so satisfactorily that it is now proposed to extend it to Steglitz, and also to apply the electric system to a tramway at Charlottenburg. At first the authorities found some difficulty in arriving at a proper definition of the new means of conveyance, and for a time determined to class it amongst the ranks of one horse tramcars, a decision which limited the average speed of the car to fifteen kilos. (9·3 miles) per hour, and the greatest speed at any moment to twenty kilos. (12·4 miles) per hour. As a matter of fact, we believe double this speed could be obtained with ease and safety. The railway at present works regularly in connection with the trains on the Berlin and Anhalt line.

The principle of the Siemens electric railway is now well known. A dynamo-electric

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machine—the generator—driven by a steam engine sends a current of electricity through some metallic conductor—in this case the rail—to a similar machine—the motor—mounted on wheels, to which it is coupled by mechanism. The electric current rotates the motor, and through it the wheels whereupon the train moves. The two machines being

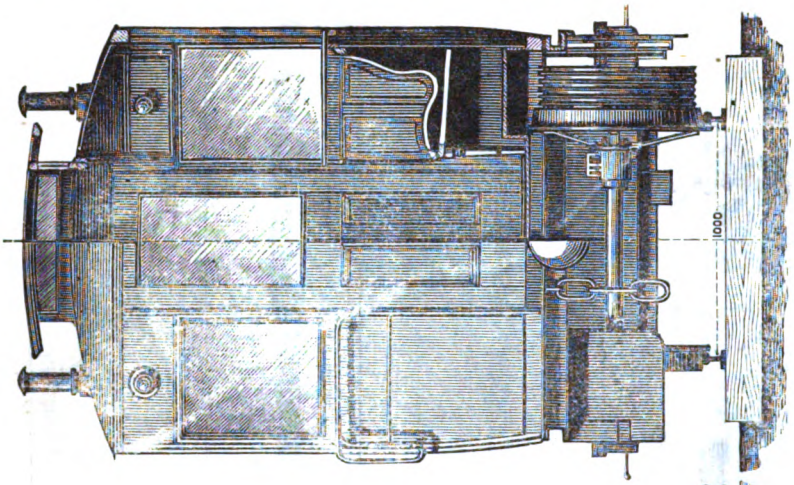

FIG.14 SECTIONAL END VIEW

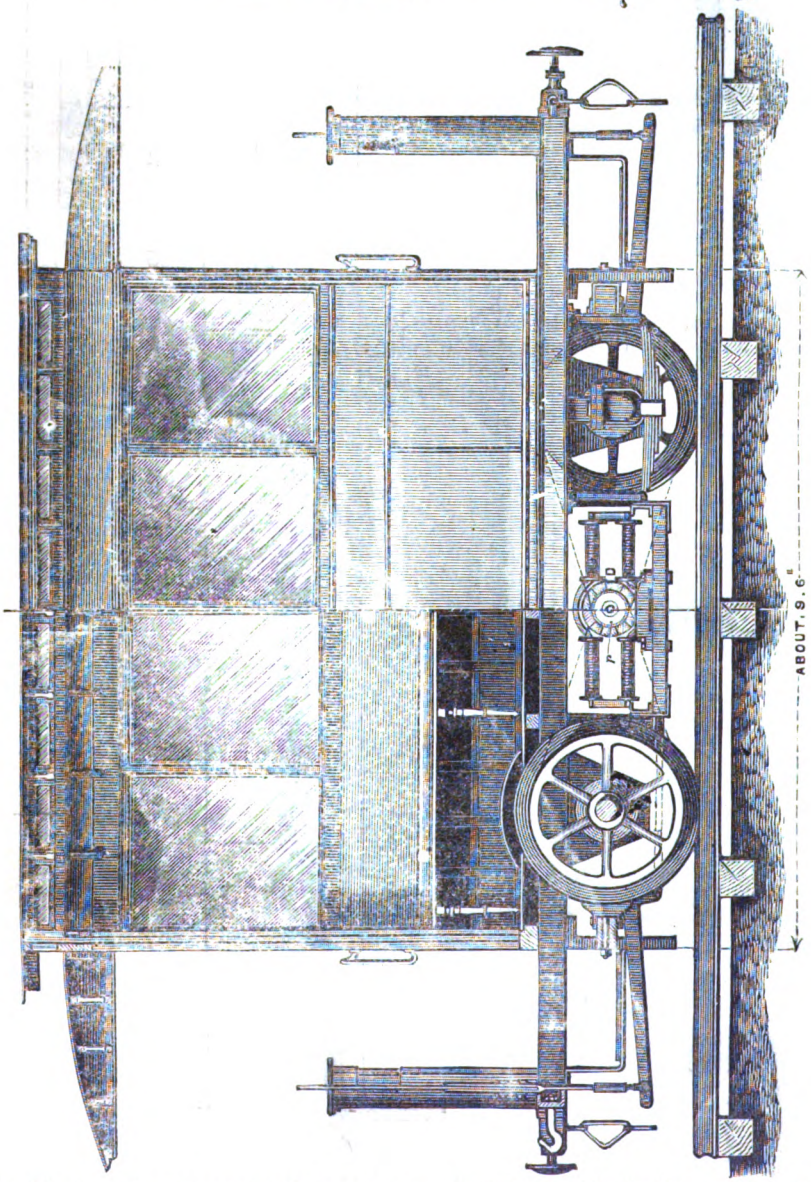

FIG.13 SECTIONAL ELEVATION OF CARRIAGE

similar, either of them is able to act as a generator or as a motor; and thus, if the train be propelled by any other means—*e.g.*, in running down an incline—the motor becomes a generator, and sends back electricity to the original generator, by which it can be converted into useful work. The result is that in practice the motor machine always generates a current of a certain strength, which goes in the opposite direction to the driving current and diminishes its effects. The amount of this diminution varies with the speed at which the train travels, being less—within the limits of practice—as the speed is higher, and *vice versâ*. As a consequence of this, it is found in practice that definite relations exist between the inside conductors, the coils of wire within the machine, and the outside conductors, and that the resistance of the last should not be higher than the resistance of the machine itself, otherwise the loss of effect is increased. Hence, with a given machine, it is necessary to have conductors, which, however varied in form, do not give a resistance exceeding this

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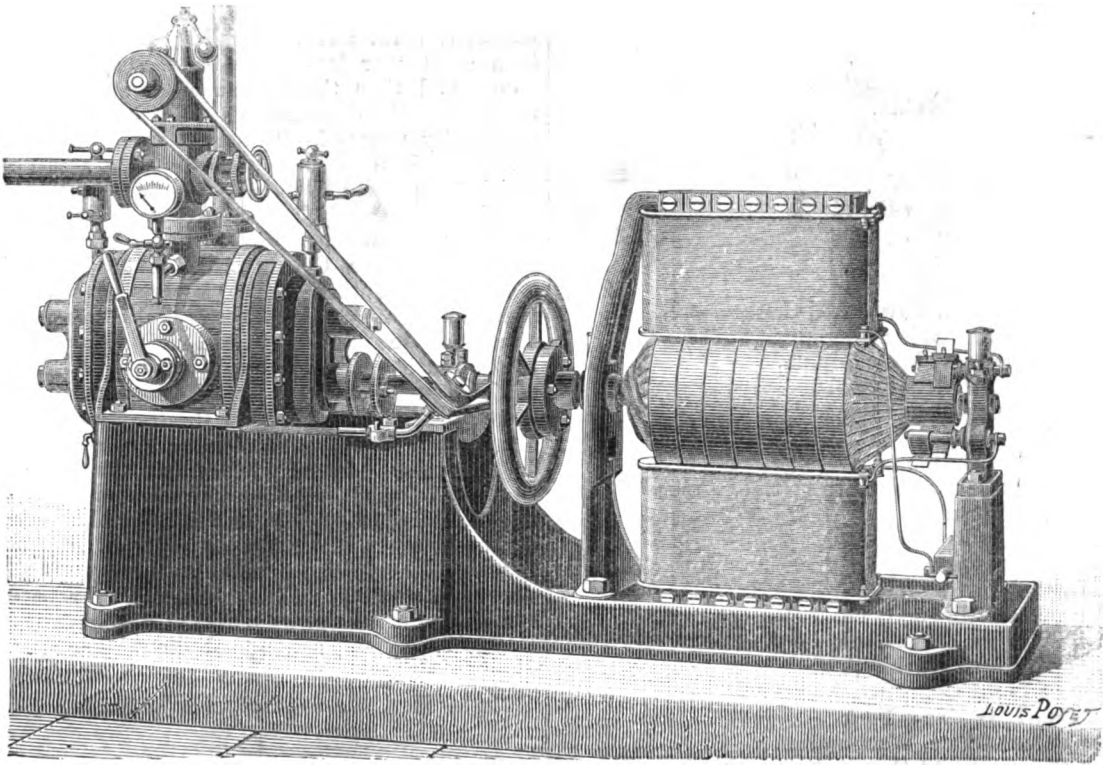
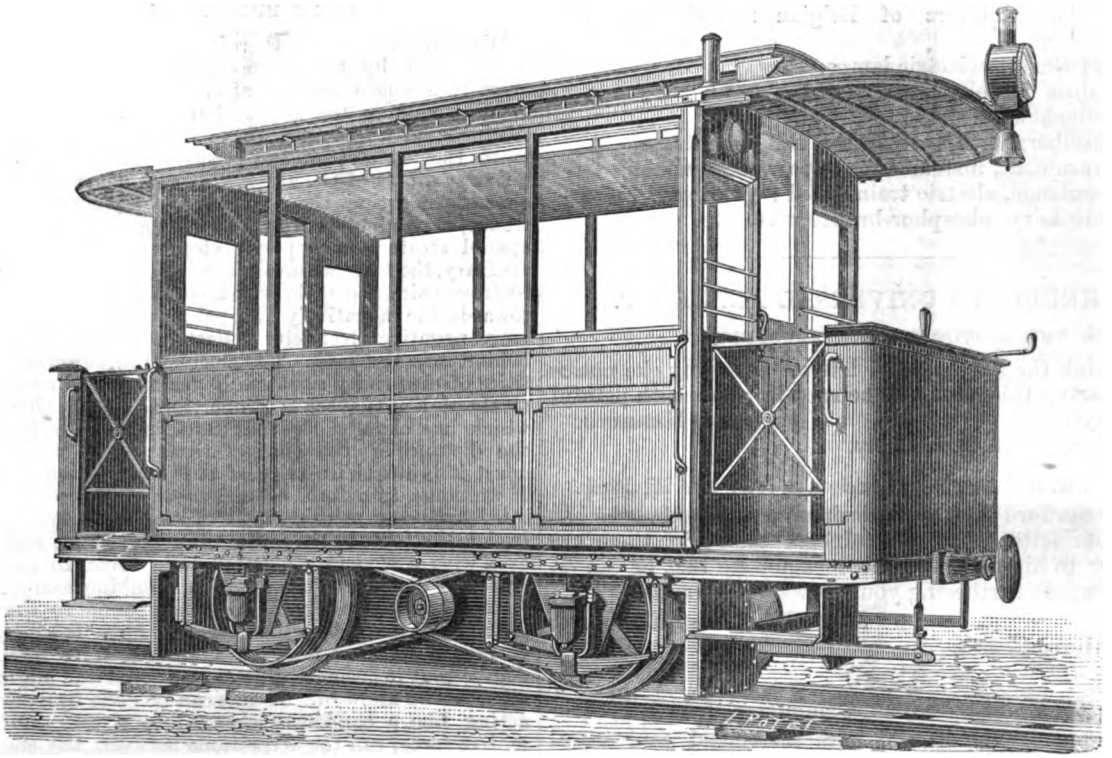
limit. Thus there is an obvious convenience in making use of the rails, which are always of section so large that even in a length of some miles their resistance does not exceed that of the wires in the machine. If separate wires are used their section must be increased at intervals by affixing additional wires or otherwise, which can be accomplished without any practical difficulty. This method, however, involves an increased expenditure of force, due to the increased section, and it is therefore desirable to find some other method of keeping the resistances within the proper limit. For this purpose, instead of diminishing the resistance of the conductor, we may increase the resistance of the machine by using longer or thinner wires for the electro-magnets and induction coil. On the Lichterfelde line the small power required makes the question of insulation of minor importance.

Should special means of insulation be required, however, many are available, the choice varying according to circumstances. In a line elevated on posts, and resting on wooden sleepers, these latter form an insulation in themselves. In a line laid upon the ground, but so that the rails rest usually on the sleepers only, and are only exceptionally in contact with the ground, even in a length of several kilometers, no special means are required; but chairs of glass, asphalte insulators between rail and sleeper, and asphalte coatings for the rails, have all been tried with success. Where, however, the line is actually laid in the street such means are insufficient. A wire tramway hung from insulators on the telegraph posts must then be resorted to, as shown in Figs. 15 and 16. A small trolly running in this way, and connected by a wire to the carriage, keeps up the electric communication. This is the method which has been adopted, we believe, on the tramway being constructed in Paris, and visitors to the exhibition will have an opportunity of forming their own opinions about it.





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AMERICAN EXHIBITORS AT THE PARIS ELECTRICAL EXHIBITION.

The following is, we believe, a correct list of the American exhibitors at the forthcoming exhibition :—

American Electric Company, New Britain, Connecticut.
Bailey, J. F., Paris.
Ball, Clinton M., Troy, New York.
Bell, Alexander Graham, Washington.
Bonwill, W. G. A., Philadelphia.
Connolly Brothers and M'Tighe, Washington.
Cumming, George, New York.
Dodgson and Egee, Philadelphia.
Dolbear, A. Emerson, Somerville, Massachusetts.
Dreyfus, Louis G., New York.
Edison, Thomas Alva, New York.
Eldridge, G. Morgan, Philadelphia.
Electric Purifier Company, Newhaven, Connecticut.
Electro Graphic Manufacturing Company, New York.
Electro Dynamic Company, Philadelphia.
Gray, Elisha, Highland Park, Illinois.
Haase, Robert, Indianopolis, Indiana.
Hirsch, Joseph M., Chicago.
Hubbard, Charles W., Boston.
Mason and Co., Volney W., Providence, Rhode Island.
Michels, John, New York.
New York Electric Light Association.
Parts, August, Philadelphia.
Phillips, W. J., Philadelphia.
Schnaussen, Theodore, Allegheny City, Pa.
Sewell, Edward W., jun., New York.
Smithsonian Institution, Washington.
Standard Electric Light Company, New York.
Tillotson and Co., L. G., New York.
United States Patent Office, Washington.
United States Electric Light Company, New York.
United States Signal Office, Washington.
Western Electric Manufacturing Company, Chicago.
Weston Electric Light Company, Newark, New Jersey.
White House Mills, Hoosac, New York.

Amongst the exhibitors of Belgian manufactures will be :—

MM. Clerc et Bureau, electric lamps.
M. Locht-Labze, pantelephones.
M. Navez, telephones.
M. Van Rysselberghe, meteorological instruments.
Belgian Government, instruments, apparatus, &c.
Colonel Leboulangé, electric train speed regulators.
M. Montefiore Lévy, phosphor-bronze wires, &c.

MR. HERRING'S UNIVERSAL ALPHABET.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I think the two enclosed letters, following the notice kindly appearing this week, will be read by many with painful interest.—Yours, &c. RICHARD HERRING.

27, St. Mary's-road, Canonbury.

30, St. James-place, London, S.W., June 27, 1881.

SIR: Sir Stafford Northcote desires me to say that he has received your letters, that the subjects raised in them are entirely new to him, and that he does not see that he can do anything towards furthering your views.—Yours, &c.,

JOHN E. EDWARDS-MOSS.

Richard Herring, Esq.

(Copy.)

27, St. Mary's-road, Canonbury, July 9, 1881.

Sir: I am sorry you should have instructed your secretary, when acknowledging the receipt of my letter, to write to me "that the subjects raised in them are entirely new to you," as I have not only a letter written at your request by Mr. Kempe, stating that as Chancellor of the Exchequer you "cannot interfere with the Postmaster-General," but I have also a letter written with your own hand in which you say "I have looked at the papers relating to Mr. Herring, but do not see that I can alter the conclusion at which the Government have already arrived." Now, my petition to the Sovereign, which was subsequent to those letters, and which petition still remains unanswered, was approved by Sir Richard Cross as Secretary of State, and specified twenty instances at least of breach of faith for which the Postmaster-General was responsible, and every instance implies in a greater or less degree a needless expenditure of my money and time through such intentional or unintentional conduct as the Government to which your letter referred was apparently aware of. To permit a resolution to be passed by a few members of the committee of a Conservative club to which I happened to belong, requiring me to withdraw my membership simply because I clearly stated my case in a constitutional manner, was further to add insult to injury. I still remain a Conservative of the old-fashioned type, believing that there is no honour or advantage either to individuals or communities in departing from a rigid adherence to straightforwardness and truth. Socially I gain by such political imbecility as fails to estimate aright my anxious endeavours. I enjoy the intimate friendship of a large number of members of the so-called political club, and one of those members is also on the committee of another club to which I belong; hence very little effort is required to estimate aright the miserable state of the case. I repeat, in conclusion, that as it is apparent the successors of the party which you lead cannot remedy the scandalous injustice of which I complain, I must look to you to devise means whereby the wrong I have suffered may be redressed and confidence in the righteousness of Conservative principles be reinstated.—I am, sir, your obedient servant,

RICHARD HERRING.

Right Hon. Sir Stafford Northcote, M.P., &c.

ON THE MODERN DEVELOPMENT OF FARADAY'S CONCEPTION OF ELECTRICITY.*

BY PROF. HELMHOLTZ.

(CONCLUDED FROM PAGE 125.)

We cannot assume, therefore, that their ponderable matter is attracted by the electrode; if this were the case, this attraction ought to last after the discharge as before. We must conclude, therefore, that the ions are drawn to the electrode only because they are charged electrically. The more the surface of the positive electrode is covered with negative atoms of the anion, and the negative with the positive ones of the cation, the more is the attracting force of the electrodes exerted upon the ions of the liquid diminished by this second stratum of opposite electricity covering them. On the contrary, the force with which the positive electricity of an atom of hydrogen situated at the surface of the electrode itself is attracted towards the negatively charged metal increases in proportion as more negative electricity collects before it on the metal, and behind it in the fluid. The electrical force acting in equal quantities of electricity situated at the inside of one of the electric strata of a condenser is proportional to the electromotive force which has charged the condenser, and inversely proportional to the distance of the charged surfaces. If these are $\frac{1}{100}$ mm. apart it is 100 times as great as if they are one millimeter apart. If we come, therefore, to molecular distances, like those calculated from the measurement of the capacity of polarised electrodes, the force is ten million times as great, and becomes able, even with a moderate electromotive force, to compete with the powerful chemical forces which combine every atom with its electric charge, and hold the atoms bound to the liquid. Such is the mechanism by which electric force is concentrated at the surface of the electrodes and increased in its intensity to such a degree that it becomes able to overpower the mightiest chemical affinities we know of. If this can be done by a polarised surface, acting like a condenser charged by a very moderate electromotive force, can the attractions between the enormous electric charges of anions and cations be an unimportant and indifferent part of chemical affinity?

In a decomposing cell the ions resist external forces striving to separate them from their electric charges. Let the current go in the opposite direction and you will have an opposite effect.

* From the *Chemical Society's Journal*.

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In a Daniell cell neutral zinc enters as cation into the electrolyte, taking with it only positive electricity, and leaving its negative electricity to the metallic plate. At the copper electrode positive copper separates from the electrolyte and is neutralised, giving off its charge to the electrode. But the Daniell cell in which this goes on does work, as we have seen. We must conclude, therefore, that an equivalent of positive electricity, on charging an atom of zinc, does more work than the same equivalent does on charging an atom of copper.

You see, therefore, if we use the language of the dualistic theory, and treat positive and negative electricities as two substances, the phenomena are the same as if equivalents of positive and negative electricity were attracted by different atoms, and perhaps also by the different values of affinity belonging to the same atom with different force. Potassium, sodium, zinc, must have strong attraction to a positive charge; oxygen, chlorine, bromine to a negative charge.

Do we perceive effects of such an attraction in other cases? Here we come to the much-discussed question of Volta's assumption that electricity is produced by contact of two metals. About the fact there can be no doubt. If we produce metallic contact between a piece of copper and a piece of zinc, opposed to each other like the two plates of a condenser, and carried by isolating rods of shell-lac, we find that after contact the zinc is charged positively, the copper negatively. This is just the effect we ought to expect if zinc has a higher attracting force to positive electricity, this force working only through molecular distances. I have proposed this explanation of Volta's experiment in my little pamphlet on the "Conservation of Energy," published in 1847. All the facts observed with different combinations of metallic conductors are perfectly in harmony with it. Volta's law of the series of tension, comprising all metallic conductors, is easily deduced from it. If only metals come into play their galvanic attractions produce instantaneously a state of electric equilibrium, so that no lasting current can occur. Electrolytic conductors, on the contrary, are decomposed chemically by every motion of electricity through their surface. Electric equilibrium, therefore, will not be possible before this decomposition has been finished, and till that stage is reached the electric motion must continue. This point has been accentuated already by Faraday, as the essential difference between the two classes of conductors.

The original theory of Volta was incomplete in an essential point, because he was not acquainted with the fact of electrolytic decomposition. His original conception of the force of contact is, therefore, in contradiction to the law of conservation of energy; and even before this law was established and enunciated with scientific precision there were many chemists and physicists, amongst them Faraday, who had the right instinct that this could not be the true explanation. The opponents of Volta's opinions tried to give chemical explanations also of those experiments of his, which were carried out exclusively with metal conductors. They might be oxidised by the oxygen of the air, and the amount of oxidation required for a very slight electric charge was so infinitesimal that no chemical analysis could ever discover it; so small that even in the highest vacuum, and in the purest specimens of hydrogen or nitrogen with which we might surround the plates, there was oxygen enough to continue the effect for years. From this point of view the chemical theory cannot be refuted. On the contrary, the so-called chemical theory of Volta's fundamental experiments was rather indefinite—it scarcely did more than tell us: here is the possibility of a chemical process, here electricity can be produced. But which kind, how much, to which potential remained indefinite. I have not found in all the papers which have been written for the defence of the chemical theory, a clear explanation why zinc opposed to copper in liquids, where zinc really is oxidised and dissolved, becomes negative, and why in air and other gases it becomes positive, if the same cause—namely, oxidisation, is at work. The hypothesis, on the contrary, of a different degree of affinity between the metals and the two electricities gives a perfectly definite answer. I do not see why an actual chemical process should be wanted to charge the zinc and copper on contact; but you see that the forces which, according to their hypothesis, produce the electric effects, are the same as those which must be considered as the cause of a main part of all chemical actions. Again, the electric charges produced by contact of zinc and copper are very feeble. They have become measurable only with the help of the latest improvements introduced into the construction of electrometers by Sir W. Thomson; but the cause of their feeble intensity is evident. If you bring into narrow contact two plain and well polished plates of zinc and copper, the quantity of electricity collected at both sides of their common surface is probably very great; but you cannot observe it before having separated the plates. Now, it is impossible to separate them at the same instant over the whole extent of their surface. The charge which they retain will correspond with the inclined position which they have at the moment when the last point of contact is broken. Then all the other parts of the surfaces are already at a distance from each other infinitely greater than molecular distance, and conduction in metals always establishes nearly instantaneously the electric equilibrium corresponding to the actual situation. If you wish to avoid this discharge during the separation of the plates one of them must be isolated; then, indeed, we get a far more striking series of phenomena—those belonging to electricity of friction. Friction, probably, is only the means of producing a very close contact between the two bodies. If the surfaces are very clean and free from air—as, for instance, in a Geissler tube—the slightest rolling contact is sufficient to develop the electric charge. I can show you two such tubes exhausted so far that very high electric tension is necessary to make the vacuum luminous, one containing a small quantity of mercury, the other the fluid compound of potassium and sodium. In the first the negative metal is intensely negative relatively to glass, in the second the metal is on the positive extremity of Volta's series; the glass proves to be more positive also in this case, but the difference is much smaller than with mercury, and the charge is feeble. Faraday very often recurs to this to express his conviction that the forces termed chemical affinity and electricity are one and the same. I have endeavoured to give you a survey of the facts connected with the question, and to avoid as far as possible the introduction of hypotheses, except the atomic theory of modern chemistry. I think the facts leave no doubt that the very mightiest among the chemical forces are of electric origin. The atoms cling to their electric charges, and opposite electric charges cling to each other; but I do not suppose that other molecular forces are excluded, working directly from atom to atom. Several of our leading chemists have lately begun to distinguish two classes of compounds, viz., molecular aggregates and typical compounds, the latter being united by atomic affinities, the former not. Electrolytes belong to the latter class. If we conclude from the facts that every unit of affinity is charged with one equivalent either of positive or of negative electricity, they can form compounds, being electrically neutral only if every unit charged positively unites under the influence of a mighty electric attraction with another unit charged negatively. You see that this ought to produce compounds in which every unit of affinity of every atom is connected with one, and only one other unit of another atom. This, as you will see immediately, is the modern chemical theory of quantivalence, comprising all the saturated compounds. The fact that even elementary substances, with few exceptions, have molecules composed of two atoms makes it probable that even in these cases electric neutralisation is produced by the combination of two atoms each charged with its full electric equivalent, not by neutralisation of every single unit of affinity. Unsaturated compounds with an even number of unconnected units of affinity offer no objection to such an hypothesis; they may be charged with equal equivalents of opposite electricity. Unsaturated compounds with one unconnected unit, existing only at high temperatures, may be explained as disassociated by intense molecular motion of heat in spite of their electric attractions. But there remains one single instance of a compound which, according to the law of Avogadro, must be considered as unsaturated even at the lowest temperature, namely, nitric oxide (NO), a substance offering several very uncommon peculiarities, the behaviour of which will be perhaps explained by future researches. But I abstain from entering into further specialities; perhaps I have already gone too far. I would not have dared to do it had I not felt myself sheltered by the authority of that great man who was guided by a never-erring instinct of truth. I thought that the best I could do for his memory was to recall to the minds of the men by whose energy and intelligence chemistry has undergone its modern astonishing development, what important treasures of knowledge lie still hidden in the works of that wonderful genius. I am not sufficiently acquainted with chemistry to be confident that I have given the right interpretation, the interpretation which Faraday himself would have given, if he had been acquainted with the law of chemical quantivalence. Without the knowledge of this law I do not see how a consistent and comprehensive electro-chemical theory could be established. Faraday did not try to develop a complete theory of this kind. It is as characteristic of a man of high intellect to see where to avoid going further in his theoretical speculations for want of facts as to see how to proceed when he finds the way open. We ought, therefore, to admire Faraday also in his cautious reticence, although now, standing on his shoulders, and assisted by the wonderful development of organic chemistry, we are able, perhaps, to see farther than he did. I shall consider my work of to-day well rewarded if I have succeeded in kindling anew the interest of chemists in the electro-chemical part of their science.

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EASTERN TELEGRAPH COMPANY (LIMITED).

The eighteenth half-yearly ordinary general meeting of this Company was held on the 14th inst. at the Terminus Hotel, Cannon-street, under the presidency of John Pender, Esq., M.P., the Chairman of the Company.

The SECRETARY (Mr. George Draper) read the notice convening the meeting and the minutes of the last half-yearly meeting, which were confirmed. An abstract of the report and accounts appeared in *The Electrician* last week.

The CHAIRMAN, in moving the adoption of the report and accounts, and the declaration of the dividend and bonus therein recommended, stated that the revenue for the six months to the 31st of March last amounted to £302.158, against £291,194 in the corresponding period, being an increase of £10,964. This increase was to some extent accounted for by the improved return on their investment in the South African Company, which gave them a dividend at the rate of 6 per cent. and a bonus of 4 per cent. per annum, against a dividend of 6 per cent. last year. The ordinary expenses of the year had been £67,754, or a decrease of £883 over the corresponding period. He had generally on those occasions been able to congratulate them that their cables were in perfect working order, but he regretted on the present occasion to say that their two Bombay cables were silent. However, from information they had received they believed they were within a very short distance of the shore, and that they would be able to repair them and set them at work again on the first lull in the monsoon. Beyond a delay in the traffic, therefore, the directors had no uneasiness in the matter, as by the arrangements they had made they could carry on their traffic without any sacrifice to the shareholders. These combinations were necessary, because he had never hesitated to say that a submarine telegraph was a more or less speculative investment; but by the experience they were gaining daily of such property, they knew more and more how to deal with it, and they had what they might regard as a fair property. The item of repairs was large, but from the commencement it had been under 10 per cent. of their capital. He congratulated them on their being able to pay a little addition to the dividend, and he hoped that that addition might be still more hereafter. To enable them to pay a steady dividend, and to give their property something like a good footing in the general market, they thought it was most important that they should add to the reserve fund. They felt now that that was getting to a fair amount, but they could not feel that they had sufficient to enable them to say that they were perfectly independent. He therefore trusted that the policy of the directors of adding largely to the reserve fund—thus increasing the value of the property—and gradually, he hoped, increasing the dividend, would meet with the approval of the large body of the shareholders. He then moved the resolution.

The VICE-CHAIRMAN (the Marquis of Tweeddale) seconded the motion.

Mr. STOKES asked what idea the directors had as to the amount to which the reserve fund should be increased.

Mr. WEIR expressed great satisfaction at the nature of the investments made by the directors on account of the reserve funds. He also asked the approximate cost of repairing the breakages referred to.

Mr. HIRST considered that the report must be regarded with great satisfaction by the shareholders, particularly as the idea shadowed forth at a former meeting by the chairman as to an increased dividend had been realised. He warmly approved the policy of a good reserve fund.

Mr. HUNTER asked when the debentures on which 6 per cent. interest was being paid would mature, and whether the directors had considered the formation of a 4½ per cent. debenture stock to replace the debentures as they matured.

The CHAIRMAN thought he might gather from the remarks which had been made that the report met with general approval from the shareholders. In reply to the questions asked, he stated that the ultimate amount of the reserve fund would depend upon the experience they gathered every year of the state of the cables. The debentures referred to would expire in 1883. They were considering the question of replacing them at a lower rate of interest, which there was no doubt they would be able to do should the present state of the money market continue. He should consider that the cost of repairing the breakage would not be much.

Mr. JOHN NEWTON pointed out, as showing the stability of the property, that every breakage had been repaired, and very speedily.

The CHAIRMAN stated that this was so, and the repair of a breakage had proved merely a question of time. The motion was then put and carried unanimously. The chairman said he must remind them, as to the direct line which they had acquired through France to Egypt, that it had been a good bargain for them; and they expected before long to have a further direct line through another important part of Europe, thereby adding to the value of their property.

On the motion of Dr. WALLER, seconded by Mr. STOKES, a hearty vote of thanks was passed to the chairman and directors.

The CHAIRMAN acknowledged the compliment, and in reply to a question, expressed his belief that the Oriental Telephone Company would prove valuable to the interests of this Company.

The meeting then separated.

A full report of this meeting will be published in our next issue.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY (LIMITED).

Supplementary report of the directors, to be presented to the eighth ordinary general meeting of the Company, Wednesday, July 20th:—With reference to the paragraph in the report, dated 11th March, 1881, in which the directors announced that actions had been commenced for the recovery of monies which they were advised were improperly expended in the promotion of this Company and the Great Western Telegraph Company, they have now to report that they have good reason to believe that a compromise of these actions, as against the great majority of the defendants, can be effected, whereby the Company will receive a sum of £100,000 in cash, and £110,000 nominal in shares, with liberty to the defendants to substitute for the latter the fixed sum of £8 per share, and reserving the rights of the Company as against the remaining defendants, the Company defraying its own expenses, and conceding to the liquidators of Hooper's Telegraph Works (Limited), one moiety of such portion of the assets of the Central American Telegraph Company (Limited) as may be agreed or determined to belong to this Company in respect of their claim upon the Central Company. The directors are unanimously of opinion, having regard to all the circumstances, that it will, in the interests of the Company, be expedient to make such a compromise as above referred to, but having regard to the magnitude of the amount at stake they are unwilling to exercise, without the approval of the Company, the powers vested in them by the Articles of Association. A resolution on the subject will, therefore, be submitted to the meeting. The retiring directors are Sir Henry Drummond Wolff and Mr. D. H. Goodsall, who are eligible for re-election. The auditor, Mr. Weise, retires, and is eligible for re-election.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).

Report of the Directors for the half year ending 30th June, 1881, to be presented at the twentieth ordinary general meeting of shareholders to be held at the company's offices, 61, Old Broad-street, E.C., on the 20th day of July, 1881. The Directors beg to submit, duly audited, the balance-sheet and accounts for the half year ended 30th June last, from which it will be seen that the gross receipts, including the balance brought from last account, amount to £18.503 9s. 1d., and the gross expenditure to £5,714 6s. 2d, leaving a sum of £12,789 2s. 11d. to the credit of revenue account. Of this, the sum of £3.750 11s. 9d. has been placed to the reserve fund, increasing that fund to £40.000. After providing for the preference dividend, a balance of £6,038 11s. 2d. remains, out of which the Directors recommend the payment of a dividend on the ordinary shares at the rate of 7 per cent. per annum, the same rate as was paid for the corresponding period of last year, free of income tax, which will absorb £5,600, and leave £438 11s. 2d. to be carried forward to the current half year's account. The Directors have much pleasure in reporting that the new cable contracted for with Messrs. Hooper's company to replace the original one was laid from Cienfuegos to Santiago de Cuba by the ss. "Hooper" in February last in perfect working order and excellent electrical condition, and has continued to work most satisfactorily. The shareholders will also be pleased to learn that the Company's other cables continue in good working order. The suit instituted against the Spanish Government at Havana for a return of the tax (about £1,000) erroneously levied on the Havana-Santiago business has been decided by the Court there in favour of the Company, but the decision having been appealed against to Madrid, it will be several months before a final settlement of the case can be looked for. The Director who retires from the Board at this time is Mr. Neil Bannatyne, who, being eligible, offers himself for re-election. Mr. James Cowan, the auditor, also retires, and offers himself for re-election.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices July 13.		Business Done Week Ending July 13. Highest.	Lowest.
Anglo-American	53¼, ⅜		53⅝	52⅛
Do. Preferred	85, 86		85⅛	84½
Do. Deferred	25, 26		25⅛	24⅛
Brazil Submarine	10¼, ⅜		10⅛	10⅛
Cuba	9¼, ⅜		9⅛	9⅛
Do. Preference	16¾, 17¼		16⅞	16⅛
Direct Spanish	4¼, 5		5	4 5-16
Do. Preference	13¼, 14½		—	—
Direct United States Cable	10⅞, 11⅛		11⅛	10⅞
Eastern Telegraph	10⅛, ⅜		10⅞	10⅛
Do. 6 per Cent. Preference	12⅞, 13¼		13⅛	13⅛
Do. 5 per Cent. Debentures, 1899	106, 109		106⅛	106⅛
Eastern Extension	11⅛, ⅜		11⅛	11⅛
German Union	11, ¼		10⅞	10⅞
Globe Telegraph and Trust Company	6⅜, ⅝		6⅛	6⅛
Do. Preference	12½, ¾		12⅞	12⅛
Great Northern	13½, ½		13⅜	13⅛
Indo-European	25, 29		—	—
Mediterranean Extension	2½, 3		—	—
Do. Preference	8¾, 9½		—	—
Reuter's	12, 13		12⅛	12
Submarine	285, 295		290	288
West India and Panama	1½, 2½		2	1 15-16
Do. 1st Preference	7, ⅛		7⅛	7⅛
Western Brazilian	8⅛, ⅜		8 15-16	8⅛
West. Union 7 per Cent. 1st Mortgage	123, 128		—	—
Do. 6 per Cent. Sterling Bonds	106, 110		106⅛	106⅛

TRAFFIC RECEIPTS FOR JUNE, 1881.

Companies.	June, 1881.	June, 1880.	Increase.	Decrease
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	£2,700	3,147	—	447
Direct Spanish Telegraph Company	1,456	1,277	179	—
Direct United States Cable Company	16,080*	6,520†	9,560	—
Eastern Telegraph Company	40,074	42,522	—	2,448
Eastern Extension Telegraph Company	29,339	29,100	239	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

* At 2s. per word. † At 1s. 6d per word

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RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

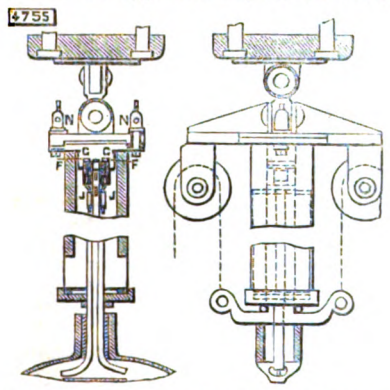
4482. CABLES FOR TELEPHONIC PURPOSES, *E. George and J. B. Morgan.—3rd November*, 1880. 6*d*.

This invention has for its object the obviation of the effects of induction, to effect which the inventors cover the telephone wires with an ordinary insulating substance, and imbed or combine with this insulator wires or metals. These wires or metals, or the outside surface of the insulating substance, are connected to earth by conductors

at intervals. The non-induction insulated or open wires or metal may be laid around, parallel to or otherwise in connection with each insulated conductor, so that when placed together such conductors form a cable; this is strengthened by a metallic core in the centre, and is surrounded by a network or riband of metal. It is carried on supports or standards. The drawing shows the system of suspending the cable.

4755. IMPROVEMENTS IN ELECTRIC LAMPS AND APPARATUS CONNECTED THEREWITH, *J. A. Berly and J. D. Hulett.—18th November*, 1880. 6*d*.

This invention relates to an apparatus for suspending electric lamps so as to enable the said lamps to be pulled down, detached, &c., to be regulated or attended to, and pushed back into their former position whilst alight. Fig. 1 is an elevation, and Fig. 2 a longitudinal section of the apparatus. In whatever position the sliding portion of the apparatus may be, the currents



from the circuit wires attached to the terminals N will be conveyed to the strips of metal J and collected by the friction pieces G, from which, through bolts, F, to which they are electrically connected, the second currents will be conveyed to the lamps by means of the conducting wires attached to the heads of the bolts F. The whole apparatus being enclosed, is free from dust and not liable to be damaged, which ensures regularity of working.

4831. KILLING AND CATCHING WHALES, &c., *O. C. Bjerke.—Dated 22nd November*, 1880.—(*Not proceeded with.*) 4*d*.

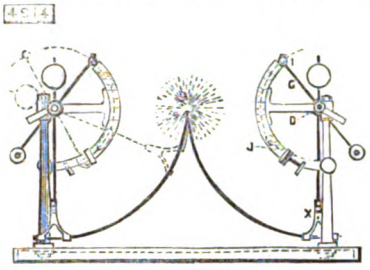
This relates to harpoons with movable barbs, and consists in so connecting them with wires from a battery as that when the harpoon enters the whale or other animal, a current of electricity will be sent with it.

4862. IMPORVEMENTS IN TELEPHONES, *S. Pitt.—Dated 23rd November*, 1880.—(*A communication from C. de Notbeck.*) 2*d*.

The inventor closes the mouthpiece of the transmitting telephone by pasting or cementing over it a diaphragm of paper. The vibrations are thus developed, and the entrance of dust, and rusting of the plate by moisture of the breath, is avoided.

4914. IMPROVEMENTS IN ELECTRIC LIGHT APPARATUS, *W. L. Wise.—25th November*, 1880. —(*A communication from J. A. Mandon.*) 8*d*.

This invention relates to a method whereby two carbons are kept with their upper poles in proper relative positions, notwithstanding their consumption, &c. One arrangement is that each carbon is formed as an arc of a circle, each carbon being carried and balanced by apparatus arranged so that in proportion as the carbon is consumed it will automatically move upward in a circular path about a centre coincident with that of the circle whereof it represents an arc. The figure is a side elevation of the apparatus. In operation the carbon is carried by the adjustable balance lever X supported in its insulated axis D. This axis has connected to it the second balance lever G, to which is connected by the



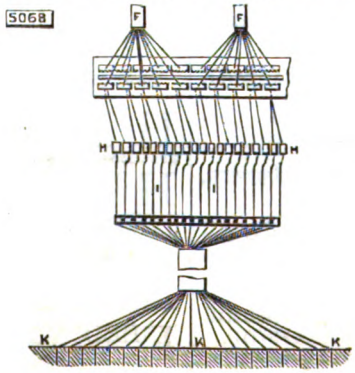
circularly curved arm I the float J immersed in the bath mercury, which is insulated and traversed by the current. The curved arm I is so proportioned and arranged that as the carbon is consumed and reduced in weight the float gradually ascends in the mercury and the curved arm emerges from the liquid, so that the loss of carbon will be correctly compensated for by a proportional upward movement thereof. The axis of the balance levers has cone centres. It works in insulated bearings. The current is conducted first to the mercury bath (itself insulated at the under part), thence through the float stem, oscillating axis, and balance levers, to the carbons. The position of the left-hand carbon when nearly consumed is shown by the dotted lines. Another arrangement is also described in the present specification.

5033. IMPROVEMENTS IN ELECTRIC LAMPS, *J. H. Johnson.—3rd December*, 1880.—(*A communication from A. de Meritens.*)—(*Not proceeded with.*) 2*d*.

This invention has for its object the production of light by means of iron rendered incandescent by electricity. The ends of two conductors are connected with two iron wires, terminating in small balls, and supported by two insulated and adjustable supports placed upon a table. The iron balls soon become red-hot, and afterwards incandescent at a white heat, but do not melt.

5068. IMPROVEMENTS RELATING TO TELEPHONIC AND OTHER SYSTEMS OF ELECTRICAL COMMUNICATION, *J. N. Culbertson and J. W. Brown.—6th December*, 1880. 6*d*.

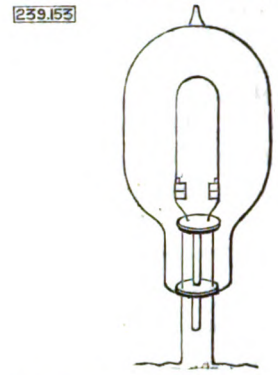
The object of this invention is to avoid the heavy insulation necessary where telephones or other lines are bunched or cabled together, rendered necessary by the fear of induction. To do this provision is made at the central station for coupling each wire through the call instrument, with which it is connected to a separate earth, and also at the opposite or outer end of the cable, where the wires are led away to various stations; several wires are coupled through instruments



to separate and independent earth plates having no metallic connection with one another. The commutator at the cental station is also so arranged that when any one wire is coupled to any other wire they may also be coupled to an independent earth plate, preferably through a resistance coil. In the figure F F are cables of wires from different stations; G are lightning protectors; H are electro-magnet call instrument apparatus; I, wires from such apparatus to one or other of the bars A of the commutator; C C are the separate earth connections; K K are the separate and independent earth plates.

239,153. ELECTRIC LAMP, *Thomas A. Edison, Menlo Park, N.J.—Filed August* 27th, 1880.

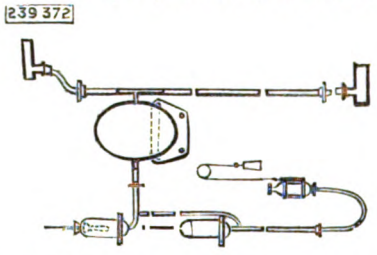
Claim.—(1). The combination with the glass enclosing globe and incandescing conductor of an electric lamp, of a support hermitically sealed to the globe, and supporting the carbons at a distance above the point of sealing, substantially as



set forth. (2). The combination, with the conductors of an incandescent electric lamp, of a glass support, to which the conductors are sealed at two or more points, one near the clamps and one where the conductors enter the enclosing globr, so that the latter point is removed a little distance from the former, substantially as set forth.

239,372. TESTING ELECTRIC LIGHT CARBONS, *Thomas A. Edison and Charles Batchelor, Menlo Park, N.J.—Filed August 9th*, 1880.

Claim.—(1) The combination, with a globe or chamber, of a much larger chamber or reservoir connected to air-exhausting apparatus, which maintains therein a high degree of exhaustion, substantially as set forth. (2) The combination of a proving chamber or globe, a mercury reservoir for sealing the same, and exhaust reservoir or chamber and means for exhausting the same, substantially as set forth. (3) The combination of a globe or chamber, a second and much larger globe, chamber, or reservoir, a



valved tube connecting them, means for maintaining a high degree of exhaustion in the larger reservoir or chamber, and connected thereto, and a gauge for determining the degree of exhaustion, substantially as set forth. (4) The combination, with the globe or chamber of a proving lamp, of a mercury reservoir connected to the globe or chamber, so that the stopper thereof may at will be covered or not covered by mercury, substantially as set forth. (5) The method of testing carbons consisting in subjecting them to the action of a current in a temporarily exhausted globe or receiver prior to their embodiment in completed lamps, substantially as set forth.

239,818. TELEPHONE, *Joseph T. McConnel, Braddock, assignor to himself and Edward A. Kitsmiller, Hawkins Station, Pa. — Filed November 15th*, 1880.

Claim.—A receiving telephone having three or more posts or points of attachment for electric circuit wires, two of which are connected by a make-and-break mechanism on such telephone, in combination with a separate battery transmitter, a main line circuit passing through the receiving telephone proper by the unconnected posts, and through the secondary coil of the transmitter, a local battery and a local circuit from such battery, through the speaking telephone and primary coil of the transmitter, to the two posts on the receiver, which are connected by the make-and-break mechanism, substantially as and for the purposes set forth.

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TELEGRAPH CONSTRUCTION and MAINTENANCE COMPANY (Limited).

NOTICE is HEREBY GIVEN that the TRANSFER BOOKS of the Company will be CLOSED from the 11th to the 19th inst., both days inclusive, preparatory to the payment of an ad interim DIVIDEND of 12s. per share to all Shareholders on the Register on the 11th inst.

By order,
W. SHUTER, Secretary.

ELECTRIC LIGHTING.
THE
ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION
(LIMITED).
Capital £800,000; First Issue £400,000.
VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates, and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation is also prepared to receive applications for licences, or for concessions for defined districts, and to enter into negotiations with responsible parties for the sale of licences for the British Colonies. The superiority of the Brush system in economy and simplicity being thoroughly established, its rapid development is now assured.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians,
86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.
Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha. India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

JOHNSON'S TRANSMITTER
(PATENT).
LOUD AND CLEAR. NO JARRING.
PERMANENT ADJUSTMENT.
NO OXIDATION. ONE LOCAL CELL.
TASKER, SONS & CO.,
ELECTRIC AND TELEPHONIC ENGINEERS,
SHEFFIELD.

VULCANITE.
HARBURG INDIA-RUBBER COMB COMPANY.
LONDON WAREHOUSE: F. WINTER.
138, LONDON WALL, WOOD ST., E.C.
EBONITE.

DUNCAN WALLET & CO.,
BONDED STORE AND PROVISION MERCHANTS,
15, BILLITER STREET, LONDON.
Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.
Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.

NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

ESTABLISHED 1851.
BIRKBECK BANK.—Southampton Buildings, Chancery Lane.
Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.
HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.
HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
Southampton-buildings, Chancery-lane

FERD. CAPITAINE, Civil Engineer, 178, BOULEVARD VOLTAIRE, Paris.
Special attention given to every branch of applied electricity. Patents of Inventions applied for and worked on the Continent. Companies formed. Representation at Exhibitions. Commission Agent.

ASSISTANT ENGINEERS WANTED for an Electric Light Company.—Reply to X 45, care of J. W. VICKERS, 5, Nicholas-lane, E.C.

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SLIP

ELECTRIC LIGHT AT MELBOURNE.—The project to light the Eastern Market with electric light has been given up.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this company for last week amounted to £2,827.

IRELAND.—Mr. Sanger, the Postal Telegraph engineer for Ireland, is suffering from an illness occasioned by exposure to the sun.

ELECTRIC LIGHT IN PARIS.—The towers of the cathedral of Notre Dame were to be lit up by electricity, according to the *Ville de Paris*, during the *fête*.

GRAPHITE.—Herr Muraska finds that graphite is a better conductor than any other carbon, its resistance at the same time being most sensitive to variation of temperature.

TELEGRAPHS IN JAMAICA.—Advices from Jamaica say that the transactions and revenue of this branch of the public service continue to increase most rapidly and satisfactorily.

WEST INDIES.—The St. Lucia and St. Vincent cable being now repaired telegraphic communication is restored with the islands of Guadaloupe, Dominica, Martinique, and St. Lucia.

TELEGRAPHIC COMMUNICATION IN FRANCE.—Telegraphic communication in France on the night of Tuesday last was very much interrupted, owing to the stormy state of the weather.

KING KALAKUA.—The King of the Sandwich Islands visited the works of the Telegraph Construction and Maintenance Company on Thursday last, accompanied by Mr. John Pender, M.P.

GREAT NORTHERN TELEGRAPH COMPANY.—The Great Northern Telegraph Company state that their lines to China and Japan are not interrupted, but are open for the transmission of telegrams to those parts of the world.

ELECTRICAL CONGRESS AT PARIS.—Dr. R. Roig y Torres, says the *Cronica Cientifica*, of which paper Dr. Torres is director, has been nominated by the provincial deputation of Barcelona as its delegate at the Congress of Electricians.

THE RESERVE SQUADRON.—On the occasion of the recent visit of the reserve squadron to Kiel in Germany, a grand garden *fête* was given in honour of our officers. The garden at the Bellevue was illuminated by the Siemens electric light.

EASTERN EXTENSION TELEGRAPH COMPANY.—This company announce that the coupons on their £320,000 Six per Cent. Debentures, due August 1, will be paid on and after that date on presentation of the same at the Consolidated Bank.

ELECTRICAL MEASURES.—In the *Journal Télégraphique* for June, M. Rothen, the Director-General of Swiss Telegraphs, continues his article on "Electrical Measures," which he has written in view of the approaching Congress of Electricians.

POSTAL TELEGRAPHS.—Mr. E. Graves, the engineer-in-chief of the Postal Telegraphs, was taken suddenly ill on Saturday last in consequence, it is thought, of a slight sunstroke. He is now reported much better, and resuming his official duties.

UNIVERSITY COLLEGE, LIVERPOOL.—Dr. O. J. Lodge has been appointed to the Lyon Jones Professorship of Experimental Physics and Mathematics by the Councils of the Liverpool University College and of the Royal Infirmary School of Medicine.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this company for the week ending 15th July, 1881, amounted to £1,901, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

ELECTRIC LIGHT IN DUBLIN.—Last week Stephen's-green and Nassau and Dawson-streets, in Dublin, were lighted exclusively by the Brush electric lamps. The increase both in the quantity and quality of the illumination by the electric system is said to have given very great satisfaction.

ELECTRIC LIGHT COMPANY FOR AFRICA.—It is announced that the Cape Electric Light and Telephone Company has been formed, with a capital of £50,000, to acquire, among other rights, the licenses to use the invention of C. F. Brush for electric lighting within the colony of the Cape of Good Hope.

PRICES.—The prices as quoted are, for gutta percha per lb., genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber, fine Para, 3s. 6½d.; Negrohead, 2s. 3½d.; Central American, 1s. 11d. to 2s. 5d.; Assam and Pegu, 1s. 3d. to 2s. 1d.; other East Indian, 1s. 9d. to 2s. 4d.; Madagascar and Mozambique, 1s. 6d. to 2s. 4d.

WEST INDIA AND PANAMA TELEGRAPH COMPANY.—The traffic receipts of this company for the half month ended the 15th of July amounted to £2,116, as compared with £1,926 in the corresponding period of 1880. The February receipts, estimated at £4,320, realised £4,421, and the March receipts, estimated at £5,050, realised £5,184.

ELECTRIC LIGHTING AT BERLIN.—It is announced that the Opera-square in Berlin will no longer be lighted by electricity, owing, amongst other things, to the difficulty of finding a suitable place for the location of the machines. Lighting by electricity will, however, we believe, have a public trial in some other quarter of the city.

DIRECT UNITED STATES TELEGRAPH COMPANY.—The eight ordinary general meeting of this Company will be held at the Cannon-street Hotel on the 28th inst. to receive the report of the directors for the half year ending the 30th of June. A final dividend of 5s. per share will be declared, making, with the three interim dividends already paid, 5 per cent. for the year.

SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The *Journal* for June (No. 37, Vol. X.), is now published. It contains, amongst other things, papers by Mr. Fox Pitt on the "Application of Electricity to Lighting;" Mr. Preece on "Radiophony;" Mr. Luke on the "Field Telegraph in Afghanistan;" also original communications and abstracts of papers.

GLOBE TELEGRAPH AND TRUST COMPANY.—The eighth ordinary general meeting of this Company will be held at Cannon-street Hotel on the 29th inst. to receive the report of the directors. A final dividend of 3s. per share will be recommended, making with former distributions a total dividend for the year of 6 per cent. on the Preference and 4½ per cent. on the Ordinary shares.

AN INVENTORS' CONGRESS.—A correspondent of the *Scientific American* suggests the holding of an inventors' congress at Washington, in November next, each State of America sending delegates, with the object of discussing the question of Patent Laws, &c. The question of the holding of an International Inventors' Congress at Paris, London, or Washington would also be discussed.

TORNADO IN MINNESOTA, U.S.A.—The State of Minnesota has been visited by one of those tornados which occur now and then in America. The telegraph lines in the State have suffered severely, one account saying that the storm destroyed everything in its path, which was one mile wide

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and forty miles long. Lightning and thunder accompanied the storm and assisted in the work of destruction.

INTERNATIONAL EXHIBITION AT FRANKFORT.—*La Lumière Electrique* says that the International Exhibition of Models and Patents now being held at Frankfort includes several kinds of electrical apparatus. Amonst other things is the rotary steam engine constructed by Prince Dolgorouki, and used by Messrs. Siemens and Halske to drive their dynamo machines. It is described in our issue of the 16th July in connection with the Berlin Electric Railway.

GERMANY AND THE ATLANTIC CABLES.—The United German Telegraphic Company have made an arrangement with the Anglo-American Company to secure the exclusive use of one of their Transatlantic cables. Connection is to be established with Valencia by a wire from Creetsiel, in East Friesland, passing through the Baltic, the Channel, and round the west coast of Ireland. Telegraphing to America from Germany will, in consequence, be as cheap henceforth as from England.

RAPID TELEGRAPHIC COMMUNICATION WITH NEW ZEALAND.—The *Colonies and India* says:—"As showing how rapidly telegraphic communication with the mother country can be carried on, it may be mentioned that the Premier, on a Saturday afternoon, sent a message to the Agent-General at London, and received the reply on the following day at Woodville, the entire course of telegraphing to England and back and transmitting the reply to Woodville occupying under twenty-four hours."

PROPOSED TELEGRAPH EXTENSION TO KILCHATTAN BAY.—With reference to the proposed extension of telegraphic communication to Kilchattan Bay, in Scotland, the authorities have intimated, after survey of the route by the Government officials, that the proposed line will not be granted unless a guarantee of £75 a year is given for eight years. The matter will thus stand in abeyance until it is seen whether the inhabitants of Kilchattan Bay and district are prepared to give the required guarantee or not.

THE METROPOLITAN TELEGRAPHISTS.—In response to a sensational and somewhat spitefully worded invitation, asking the staff of the metropolis to show whether or not they were satisfied with Mr. Fawcett's new scheme, two meetings were held at the Foresters' Hall on Saturday last, both of which were thinly attended. The demonstration, indeed, was so feeble that, practically, the conclusion arrived at was that active discontent no longer prevailed, and that it was useless to carry on the agitation any further.

GAS EXHIBITION AT ABERDEEN.—At the Exhibition of Appliances for Lighting, &c., by Gas, to be held at Aberdeen from September 19th to October 1st, under the auspices of the Aberdeen Philosophical Society, the quadrangle of the Marischal College, in which the exhibition is to be held, will be available for the electric light as adapted to public illumination, and the exhibition halls and entrance halls for indoor illumination. Applications should be addressed to Mr. A. D. Milne, secretary, Aberdeen.

ELECTRICAL INSECTS.—Two fresh examples of insects capable of giving electrical shocks have just been brought to the notice of the Entomological Society. A letter from Lady de Grey, of Groby, described a shock caused by a beetle, one of the *Elateridæ*, the effect of which was felt as far as the elbow. The other case is that of a large hairy lepidopterous caterpillar of South America. Captain Blakeney, on touching this creature, received a shock so violent that he lost the use of his arm for a long time, and his life was even considered in danger.

TRANSMISSION OF POWER.—In the large establishment of the *Belle Jardinière*, near the Pont-Neuf, in Paris, there is placed in the basement a steam engine which does various kinds of work, and, amongst others, pumps the water for distribution to the various parts of the establishment. As, however, the whole of the motive power was not used up, it has lately been requisitioned to drive two Gramme machines, which, being connected by wires, turn three sewing machines and a woodcutting saw, which are placed in the upper stories of the house.

A NARROW ESCAPE.—A wonderful escape from a flash of lightning is recorded from Nimes, in France. During a thunderstorm which took place in the afternoon of the 26th May a flash of lightning struck a large dog which was lying at the feet of a child who was seated on the ground in the suburbs of Nimes. The child was overturned by the flash, and its sabots were stripped off its feet, but the child itself was unhurt. Of the dog, however, no trace whatever could be found, and it was supposed that its body had been entirely consumed by the flash.

ELECTRICITY IN GERMAN COAL MINES.—The German colliery owners are endeavouring to substitute electricity for horses as a means of traction for their coal trams. Messrs. Siemens and Halske, of Berlin, have constructed an electric tramway at Schmidtschacht, in Upper Silesia. The current, instead of traversing the rails, will be conducted along an overhead wire, which is in connection with the cars, as shown in our illustration of the Berlin Electric Railway (Vol. VII., No. 9, p. 137, Figs. 15 and 16). At other places also this system is said to have been adopted.

NEW VARIETY OF COAL.—A GOOD CONDUCTOR.—A variety of coal, said to be the most highly-carbonised member of the coal series hitherto described, has been found near Schunga, on the western shores of Lake Onega, it contains about 91 per cent. carbon, 7 or 8 per cent. water, and 1 per cent. ash. This coal is extremely hard and dense, has an adamantine lustre, is a good conductor of electricity, and has a high specific heat—0·1922. Although containing as much carbon as the best graphites from Ceylon, it is not a true graphite, inasmuch as it is not oxidised by potassium chlorate and nitric acid, but behaves towards those re-agents like an amorphous coal.—*Jahrbuch für Mineralogie.*

TELEGRAPHISTS AND CIVIL SERVICE APPOINTMENTS.—Mr. Dillwyn having asked the Secretary to the Treasury whether the telegraph clerks who were transferred from the late companies to the Government service in 1870 were eligible for transfer to the Customs and Inland Revenue Departments, Lord F. Cavendish replied that when a member of the ordinary Civil Service was nominated to a situation out of the ordinary course, he required an additional certificate to show that he possessed the requisite knowledge, and was qualified with respect to age, health, and intelligence. If any such member was nominated from among the transferred telegraph clerks, he was eligible on the same terms as other Civil servants.

THE MAXIM LIGHT.—According to New York papers, the Secretary of the United States Electric Light Company (which controls the Maxim patents), at the annual meeting of the stockholders, held on the 7th inst., admitted the correctness of the statement recently made by Mr. Leo Daft, of the New York Electric Light Association, that the cost of producing the electric light by the incandescent system is greater than that of gas light, in the proportion of 1,500 to 992. The secretary further remarked that the only practical system of electric lighting was on the incandescent plan, and

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although at present this was more expensive than gas light, yet ultimately their apparatus would be so improved and modified as to reverse these conditions.

BERLINER'S MICROPHONE.—With reference to this microphone, which we described recently (Vol. VII., No. 3, p. 36), Mr. F. T. J. Haynes, of Taunton, writes that he made a transmitter similar to that of M. Berliner, as long ago as November, 1878, when it was described in the *Somerset County Gazette* as follows:—"The instrument consists of a diaphragm made of ferrotype plates fastened in a vertical position. In the centre of the diaphragm a piece of carbon is secured. The base of the carbon is against the back of the diaphragm, and its point rests lightly against another piece of carbon, which is fixed on the top of a brass spring. There is a screw in the rear of the spring for adjusting purposes. This simple instrument, when connected to a telephone and battery, will transmit articulate and other sounds distinctly."

ELECTRICITY AMONG THE NIHILISTS.—In our issue of the 25th of June we stated in a note that, "amongst the officers arrested as implicated in the proposed plot on the guard ship off Peterhoff against the Czar's life was a certain Lieut. Khotinski, who is also implicated in the Mala Sadowa Street plot. He has been connected with electric light production, and is said to be a man of scientific mark." Captain Khotinski now writes to say that he is the only one of that name in the Russian navy who is interested in electrical science; but that he was never concerned in any plot against the Czar, and that in fact he was staying in Paris on leave when this one was discovered. We are very glad to be able to make this correction, and can only express our regret at the error. Our information was obtained from the columns of a daily contemporary.

REDUCTION IN CABLE TARIFFS TO AMERICA.—The Anglo-American and the Direct United States Cable Companies both announce a reduction in the charge for messages to America. The charge for messages between this country and New York or Canada by both the companies' cables on and after the 1st of August next will be 1s. per word. The Anglo-American Company also give notice that on and after the same date a special rate of 6d. per word will be charged for Press messages, containing political and general news only, in plain and unabbreviated language, between the United Kingdom and New York and Canada, to be transmitted between the hours of 6 a.m. and 12 noon, Greenwich time. Arrangements for the application of this reduced rate must be made previously either at the accountant's office, No. 26, Old Broad-street, London, or with the agents of the company in the provinces.

THE FAURE BATTERY.—A variation in the form of this battery is described in a letter from Dr. J. A. Fleming, of University College, Nottingham, in *Nature*, of the 14th July. He says:—"Sheets of lead were bent up into the form of shallow trays, one foot square and one inch deep; in each of these was placed a layer of red lead, then a layer of flannel, then a layer of red lead, and lastly another lead plate. These trays to the number of six were then piled one above the other, after being filled with dilute acid. The cells being connected in series, were polarised by a 10-cell battery of Grove cells, and after twenty minutes charging, had taken up a very large quantity of electricity. At a short lecture given during the evening the charged Faure battery was connected with a Gramme machine, and drove it round with considerable velocity for some minutes. This is a convenient form for lecture-room demonstration, as it permits the structure of the battery to be exhibited to an audience."

NEW ELECTRIC LIGHT COMPANY.—The prospectus is issued of the Eastern Electric Light and Power Company, with a capital of £250,000 in shares of £5 each. First issue £150,000, of which the vendor will receive 7,600. The shares are payable, £1 per share on application, £2 on allotment, and the balance as required. This company has been formed to introduce the electric light into India and other Eastern countries, and will undertake the supply of dynamo and other electrical machinery, lamps, generators, and apparatus for the production of light, the transmission of power, the extraction of metals from ores, and similar operations. The company have purchased the Indian patents of the Brush system and also the Fox incandescent system. The directors are:—Ernest Noel, Esq., M.P.; General H. D. Abbott, C.B.; General Sir A. T. Cunynghame, G.C.B.; A. McArthur, Esq., M.P.; James Pender, Esq.; Latimer Clark, Esq.; and Major C. H. Strutt. The two latter will join the board after the allotment of shares. The materials required by the company are to be manufactured by Messrs. Latimer Clark, Muirhead, and Co., under an agreement. Mr. T. Marshall Collet is secretary, Winchester House, Old Broad-street, E.C.; Mr. Cromwell F. Varley, F.R.S., is consulting electrician.

THE PROVINCIAL TELEGRAPHISTS.—The National Conference of Telegraph Clerks was held at the Compton Hotel, Liverpool, on Sunday last, to consider the present dispute with the postal authorities. There was a large attendance, delegates being present from all the principal towns of the kingdom, including Liverpool, Manchester, Leeds, Dublin, Belfast, Edinburgh, Glasgow, Newcastle-on-Tyne, Bristol, Cardiff, Newport, Nottingham, York, Gloucester, Cork, Chester, Norwich, and Sheffield. The scheme of the Postmaster-General was discussed at length in its various details, and the chairman stated that the best evidence that could be given of the dissatisfaction with which the scheme had been received was the fact that when it was announced nearly all the best clerks in the Telegraph Service tendered their resignations, and took the first opportunity of joining the Cable Companies, while others were preparing to do the same, thus still further impoverishing the already diminished efficiency of the department. Telegrams were received from various towns expressive of sympathy, and showing that in the provinces, at all events, the telegraph clerks are by no means satisfied with the Treasury proposals.

RADIOPHONY.—At a recent meeting of the French Physical Society, M. Mercadier gave some further particulars with regard to his researches on the reproduction of speech. The transmitting apparatus was composed of a very small mirror fixed in a frame communicating with a mouthpiece, into which he talked. The rays were reflected on to a receiver formed of a glass tube containing a sheet of something blackened by smoke. With a warm sun the reproduction of speech was very clear, with a clouded sun or with less intense sources the articulation lost its clearness; musical sounds were always easily transmitted. M. Mercadier has resumed his experiments as to the method of using a battery to study the selenium receivers by. He has tried various metals. Selenium will not adhere to aluminium, silver is attacked very rapidly. With platinum, iron, copper, and brass good results have been obtained. The thickness of the cushion of selenium and its resistance did not appear to have any influence. If the resistance of these receivers be measured, by varying their temperature, it is seen that this resistance increases at first, then comes to a limit, attained at a variable time. It diminishes from 0 to 125 degrees, then increases to a maximum towards 163 degrees, and again decreases up to 210 degrees. These results are entirely in accordance

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with those that Dr. Werner Siemens has obtained with selenium wire.

TELEGRAPH INSURANCE.—A project is on foot for establishing a "Mutual Insurance and Benefit Association," confined to members of the Postal Telegraph service. The association is—we quote from the prospectus—"to combine two objects, one a system of insurance to provide a ready fund for our wives and families at our decease, the other to protect us from any isolated action on the part of the authorities." Rules for the latter portion of the proposed scheme are being prepared by the various committees. The insurance portion of the scheme, which is made public, consists of a payment of either 6d. or 3d. per week by each member, at whose death £100 or £50 respectively will be paid to his nominated representative. The existing system, the headquarters of which are at Northampton, is based on the practice of burial societies, members paying a certain contribution on the occurrence of a death among them. It also includes postal *employés*, most of whom are very much older than the telegraph staff. Thus the new scheme has its advantages; but for the purposes of insurance alone the premium strikes us as being very high, and the other objects as very vague. It is an error of judgment to invite people to join an association one half of the subscriptions to which are to be used for purposes not yet defined. We suppose that the "other benefits," such as "protection against isolated action," mean in plain English the accumulation of a fund to support strikes.

TECHNOLOGICAL HANDBOOKS.—In 1873 the Society of Arts instituted technological examinations—examinations, that is, in the theory of certain specified trades. In 1879 these examinations were transferred to the City and Guilds Institute for the Advancement of Technical Training, and considerable alterations were made in the system; but the establishment of the technological examinations rendered manifest another want besides that of instructors, and that was the want of books in which a workman belonging to any particular trade could obtain the information he required about the theory of that trade. To supply this want the Society of Arts intend publishing a series of handbooks on various subjects, which will be edited by Mr. H. Trueman Wood. Amongst those that are now in course of preparation we notice one on "Telegraphs and Telephones," by W. H. Preece, F.R.S. The books will be addressed to workmen and apprentices who may be supposed to have some knowledge of the practical if not of the theoretical portions of their business. At the same time—since the books are intended for learners—the possession of such knowledge will not be assumed, but it will be for the most part taken for granted that the student will have in his workshop the opportunity of studying the various processes of which he reads, so that practice and theory may go hand in hand. The books will not be, in any sense, cram books. They will not be written with a view to enable candidates to answer a paper of questions; but they will, if the intentions of those who are preparing them can be carried out, provide for all interested in our great manufacturing industries knowledge which, while it may to a certain extent be tested—as may all knowledge—by examination questions, will also stand the more real and severe tests of practical work.

LEGAL.—THE BELL TELEPHONE CASE IN AMERICA.—The following is the criticism of our contemporary, the *Scientific American*, on the case of the "American Bell Telephone Company *v.* Spencer and others:"—"Judge Lowell, of the United States Circuit Court, Boston, Mass., rendered an important decision on the 27th ult., in which he virtually confirms to the American Bell Telephone Company the exclusive right of talking over a wire by electricity. If this decision is correct, then the Telephone Company is in possession of one of the most gigantic and extraordinary monopolies ever obtained by an individual or acquired by a private corporation. It will almost bear comparison with the patent issued by the Spanish sovereigns to Christopher Columbus for his discovery of the New World, by which the continent, its peoples, and their possessions, were placed under his thumb and that of his heirs for ever. But the magnitude of that grant caused its ultimate downfall; and possibly the Bellonian patent may, with more justice, meet a similar fate when it reaches the Supreme Court of the United States. If it does not, if this decision stands, what a marvellous honour belongs to Alexander Graham Bell! What an astonishing benefit he has conferred upon his fellow men! He is declared to be the original and first discover of the far-reaching art of speech transmission by electricity. The suit in question was brought by the American Bell Telephone Company against Albert Spencer and others, and the decision, as we understand, is based on the fifth clause of Bell's claim, patent of February 14, 1876, as follows:—'5. The method of, and apparatus for, transmitting vocal and other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air, accompanying the said vocal or other sounds, substantially as set forth.' The Court decides that the specific method of producing the electrical undulations employed by the defendants is different from the Bell plan. The defendants' device is made on the principle of the microphone, which has been very much improved since the date of the first Bell patent. The judge says: 'If the Bell patents were for a mere arrangement or combination of old devices to produce a somewhat better result in a known art, then, no doubt, a person who substituted a new element not known at the date of the patent might escape the charge of infringement. But Bell discovered a new art—that of transmitting speech by electricity, and has a right to hold the broadest claim for it which can be permitted in any case—not to abstract right of sending sounds by telegraph without any regard to means, but to all means and processes which he has both invented and claimed.' It has been heretofore supposed by electrical laymen that Bell's devices are simply improvements upon something previously done in the same line by others, such as Œrsted, Reiss, Gray; and that, consequently, Bell's broad claim to the art of transmitting speech by electricity was an absurdity, and would be so declared whenever it was submitted to a proper judicial examination. But a trial has been had, the laymen are defeated, and the hopes of hundreds of telephonic inventors laid low in the dust. It may be, however, that the near future has relief for them in store. Judge Lowell pays a just tribute to the learning and ingenuity of Professor Reiss, but holds that his telephone of 1860 was an imperfect instrument, which, although some sounds of the voice could be sent, was still incapable of completely transmitting articulate speech. This differs from accounts we have had of the Reiss telephone, and perhaps the entire evidence in respect thereto was not brought out before the Court. It may equally be said of Bell's telephone, that while it is a good receiver it is a poor transmitter—so poor that its use has been almost abandoned in favour of superior instruments such as the Blake or the Edison. If we had to rely only on the Bell instruments the telephone would be a nuisance, and the widespread use of speaking telegraphy now enjoyed could never have been realised."

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EXPANSION VOLTAMETER.

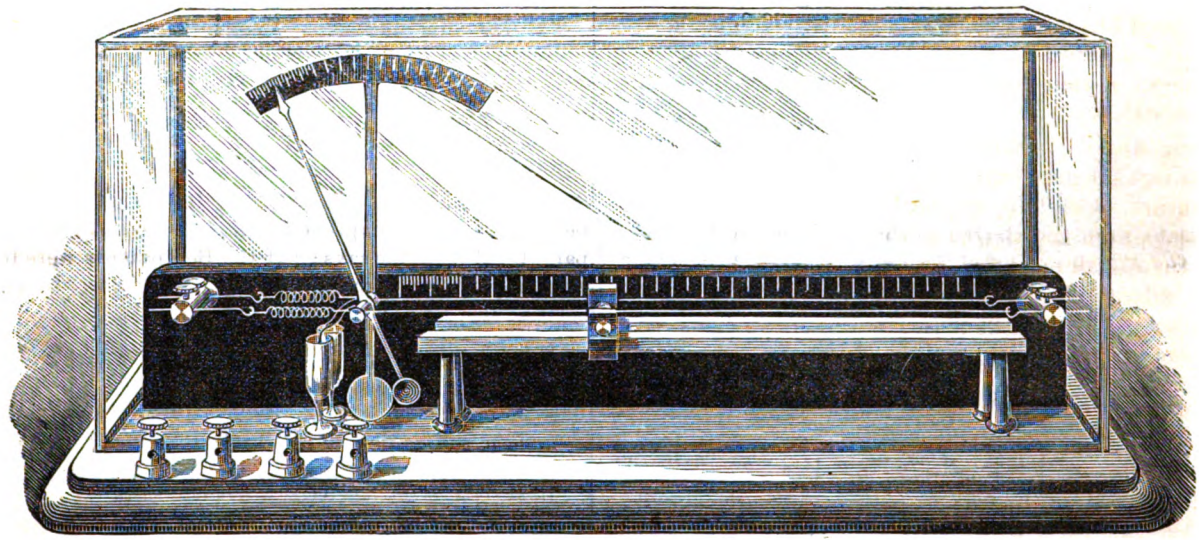
BY GEORGE M. HOPKINS.

In the ordinary voltameter where acidulated water is decomposed by electrolysis, and by which the strength of the current is determined by the volume of gas accumulating in a given time, there are several objectionable features which prevent it from coming into general use for the measurement of the strength of electric currents.

In the first place the electrolytic voltameter is incapable of indicating the strength of the current at any particular moment, and cannot, therefore, yield anything but a mean result. It offers considerable resistance in the circuit, its indications depend upon the acidity of the water and the size and distance apart of the electrodes; and to secure accurate results the temperature and barometric pressure must be taken into consideration.

The voltameter shown in the engraving depends on the heating effect of the current on a thin wire of platinum or copper, the lineal expansion of the wire giving the index more or less motion, according to the strength of the current.

This instrument, like the electrolytic voltameter, is adapted only to strong currents, and, although it has one source of error to be compensated for—that is, the increase of the resistance of the wire with the increase of temperature—no account is taken of the environing temperature nor of barometric pressure, and the indication may be read at any moment; and, moreover, the increase of resistance due to increased temperature may be disregarded, since the normal resistance of the wire is almost nothing.



This voltameter finds its principal application in connection with the stronger currents, such as are employed in electric lighting, in electro-metallurgy, and in telegraphy, and it is a convenient adjunct to the dynamo-electric or magneto-electric machine. It must be adapted within certain limits to the current which is to operate it, but when the instrument is properly proportioned to its duties its indications may be relied upon.

A verticle plate of vulcanite supports a horizontal stud, upon which are placed two metal sleeves having a glass lining. To one of these sleeves is attached a counterbalanced arm, carrying at its upper end a curved scale, having arbitrary graduations determined upon by actual trial under approximately the same conditions as the instrument will be afterward subjected to in actual use. The other sleeve carries a light counterbalanced metal index, which moves in front of the curved scale. Each sleeve is provided with a curved platinum wire arm, dipping in mercury contained in an iron cup secured to the base. Two platinum or copper wires are stretched along the face of the instrument, and attached at one end to hooks passing through an insulating post, and after passing once around their respective sleeves on the index and scale, are attached to spiral springs, which in turn are connected with wire hooks extending through an insulating post projecting horizontally from the vulcanite plate.

Below each wire there is a horizontal metal bar communicating under the base with one of the binding posts. The two other binding posts are connected separately with the two mercury cups. It will be seen that with this construction the expansion of the rear wire will move the scale, while the expansion of the front wire will move the index. In order to apply the current to any required length of wire, there is upon each of the horizontal bars a clamp, which may be placed anywhere along the bar and screwed up so as to clamp both wire and bar.

Usually the current to be measured will pass from the battery or machine to one of the binding posts, thence to the forward horizontal bar, thence through the expansion wire connected with the index, through the sleeve of the index, and finally through the mercury cup to the other binding post.

It will be observed that both scale and index will be moved in the same direction by the expansion of their respective wires, and that the atmospheric temperature affects both alike. This being true, it is unnecessary to take any account whatever of external temperature. The apparatus is enclosed in a glass case to prevent the cooling action of the draughts of air.

By connecting the index expansion wire with a battery having an electromotive force of one volt, the deflection is very slight, even with a very fine wire, but in a stronger current from a battery having an electromotive force of five volts and upward, slight variations will be readily indicated.

As mentioned before, the instrument must be adapted to the conditions under which it is to be used. For use with a moderate current, a No. 36 platinum wire, about the length of that shown in the engraving, answers a good purpose, but for heavier currents from a dynamo-electric machine a larger and longer wire of copper will be required. It should be small enough to be heated somewhat by the current, but not so small as to offer any material resistance in the circuit. When the larger wires are used they are not wound about the sleeves of the index and scale, but are bent downward before reaching the sleeves, and the mercury cups are placed so as to receive their lower ends. Cords or small chains are attached to the angles of the wires, and wrapped once around the sleeves and attached to the springs.

This instrument, placed directly in the circuit of a dynamo-electric machine or in a branch circuit, will indicate the amount of current passing. When it is desired to compare two currents the expansion wire of the index is placed in one circuit, and the expansion wire of the scale is placed in the other circuit. In a delicate instrument of this kind the tension of the expansion wires should be only sufficient to keep the wires taut, as they are readily stretched when considerably heated.

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CORRESPONDENCE.

CARBON TRANSMITTER.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I send you photographs and description of a very simple form of carbon transmitter, requiring no adjusting, and which for clearness of articulation is equal to any in the market.

FIG.1.

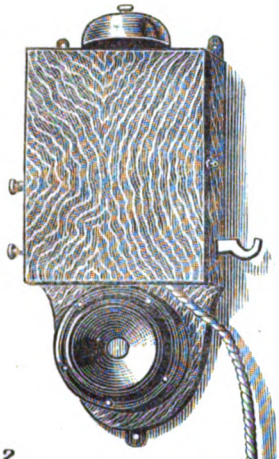


FIG.2.

FIG.3.

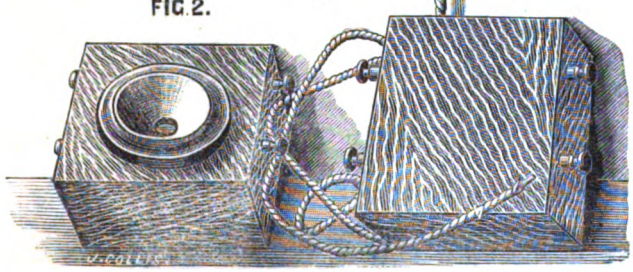


Fig. 1 is an arrangement with coil switch and call bell.
Fig. 2 and 3 different forms of transmitters with coil only.

FIG.4.

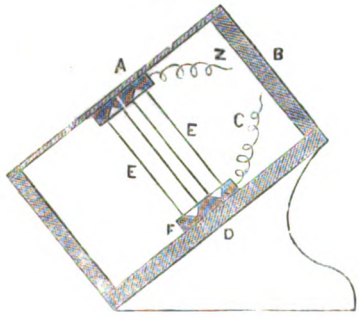
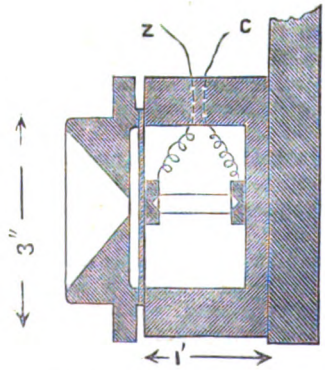


FIG.5.



The arrangement of carbon pieces is precisely the same in all, the only difference being in the number and size of them.

Fig 4 is a section of Fig. 3.

A B D. Box. Size immaterial; the smaller to, say, 3in. square the better. The diaphragm A is made of pine wood 1-16in. thick, and glued to frame B. F F are carbon blocks, about $\frac{1}{4}$in. thick, countersunk to support ends of carbon pencils E E, which must be loose enough to shake about when the lid C is screwed down.

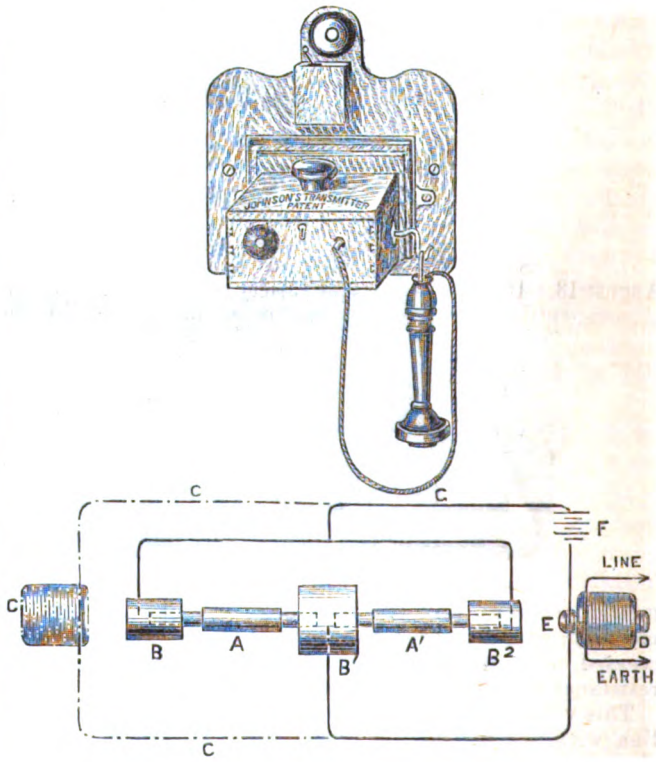
For ordinary use two carbon pencils will be found sufficient, but for loud speaking five will answer better.

The above form of transmitter has been in daily use for about 12 months, and gives entire satisfaction.—Yours, &c.,

New Briggate, Leeds. T. CUTTRISS.

JOHNSON'S TELEPHONE TRANSMITTER.

Messrs. Tasker, Sons, and Co., electrical engineers of Sheffield, have introduced to our notice Johnson's patent transmitter as an improvement upon those previously in the market. We have had these transmitters under trial, and so far have found that the inventor has not exaggerated their good qualities, for under exceptionally bad conditions, in the hands of children, with rough and hastily adjusted connections, the transmission of sounds has been clear and distinct. There is no difficulty in detecting the different voices of the speakers, and it is delicate enough to take up and transmit the vocal sounds although the speaker is at a considerable distance from the instrument. In our experiments we used two small Lechlanche cells. We give the details of construction, so that readers may judge whether it possesses the advantages claimed for it. Fig. 2 shows a section, while Fig. 1 shows the instrument as arranged for use, with push, call-bell, transmitter, and receiver complete.



A and A^1 are pencils of carbon, loosely supported in blocks B, B^1 and B^2 of the same material.

C is a shunt, of a lower resistance than the highest resistance of microphone when mounted for use.

The circuit from battery F through primary E can be made through arm A or A^1 and connection G. If this circuit should from any cause be broken, the induced extra current will pass through the shunt C, and there is no evidence in the receiving telephone of any interruption. This arrangement is intended to obviate the grating and disagreeable sounds

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in the receiving telephone that contribute to indistinct articulation. The proprietors rightly point out that in some instruments when the circuit is broken a spark passes between the carbons, gradually destroying their sensitiveness, and decreasing the efficiency of the apparatus. To remedy this, increased battery power is used, which obviously hastens the further destruction, and increases those incidental annoyances which so frequently give rise to complaints from users. The transmitter under notice has a low resistance, and the use of the shunt, as above mentioned, seems to be very effective in stopping these grating sounds. The contacts being by the same means protected, the sensitiveness of the transmitter is permanent, and its action reliable.

The question will necessarily arise as to the real improvement this instrument shows over previous ones. So far as our inspection goes, we think that the arrangement of carbons and the use of the shunt are decided improvements, and the latter is unique, otherwise the patentee might have been thought to be working on old ground without introducing anything new. A careful consideration of the diagram will, we think, show that this instrument is not a copy of anything in use.

ELECTRICITY AT THE SANITARY EXHIBITION.

On Saturday, July 16, the International Medical and Sanitary Exhibition was opened to the public in presence of a distinguished company, including Lord Granville. The Exhibition is designed to further a knowledge of sanitary apparatus amongst the people, and to display the most approved medical appliances. It has been promoted by the executive committee of the Parkes Museum of Hygiene, who are anxious to bring into public notice the beneficent work they have in charge, with a view to collecting sufficient funds for the construction of a permanent museum building.

The Exhibition is held in the galleries of the Horticultural Society at South Kensington, and is to remain open till August 13. It comprises a great variety of heating and cooking stoves, ventilators, lamps, drains, traps, and so on, together with invalid chairs, beds, ambulance equipments, surgical instruments, and medicines. One or two of these articles are, perhaps, worthy of mention before passing on to our proper subject—electricity. The sanitary screen of Messrs. Alment is designed to regulate the temperature of a room while excluding infectious germs. Tippets and capes lined with cork, for the use of ladies and gentlemen who cannot swim, are to be seen there; and Messrs. Trübner exhibit the American revolving bookcase which, within a space 36in. by 24in., contains eight shelves, and holds from 80 to 100 volumes.

The judges appointed to examine the section on electrical instruments and appliances are Mr. C. H. Golding Bird, F.R.C.S.; Dr. G. V. Poore; Professor A. W. Reinold, M.A.; and Mr. A. de Watteville, M.R.C.S.

Considering how much electricity is now employed in surgery, we expected to have seen a larger assortment of electrical apparatus at the Exhibition, though what we did see was very good of its kind. We missed, for example, those ingenious electric lights of Trouvé for illuminating the mouth in dentistry, or other inaccessible cavities of the body. But there was a fair number of very neat induction coils and voltaic batteries, elegantly fitted up, and very portable. Messrs. J. Weiss and Sons, contractors to the army and navy, 62, Strand, exhibited a variety of these, one coil being provided with a "double break" or interrupter, having a pair of spring contacts which broke the circuit successively, and thus produced a double number of sparks. One of these spring contacts played on the other, which in turn played on a fixed contact. Batteries of Leclanché, Smee, and bichromate cells, some of which were thrown into use by simply opening the lid, were also exhibited by this firm.

Messrs. S. Maw, Son, and Thompson, of 7, Aldersgate-street, London, made a very fine show of portable induction coils and batteries. One battery was especially worthy of note. It contained 60 Smee elements of a small size, with reversing key and rheostat for varying the strength of the current; an interrupter for making the continuous current intermittent; and electrodes for application of the current in cases of sciatica, bladder and throat affections, or to the ear, spine, teeth, and so on. The cells are thrown into action four at a time by pulling up the vessels charged with the liquid until they enclose the plates.

The most interesting and novel collection in the section is, however, that of Mr. J. B. Thistleton, of 1, Old Quebec-street, Oxford-street. There is a considerable variety of apparatus here, and several of the devices are worthy of attention. Moreover, the prices appeared to us very moderate. There is a Du Bois Reymond induction coil, having a pendulum interrupter which will be new to many electricians. Between the poles of a double coiled electro-magnet is suspended a soft iron pendulum, of a bottle shape. It rests against a contact spring, and when the current is put on the pendulum is pulled away from the spring by the current. The circuit being broken, it immediately falls back to the spring by its own weight. Contact being re-established, the electro-magnet attracts it as before, and so the interruption goes on. The number of breaks per second is increased by simply shifting round the suspension of the pendulum and the contact points, so as to throw the pendulum further off the vertical. A ball sliding on the upper stem of the pendulum may also be lowered so as to increase the number of vibrations per second. This device is really an improvement on Dr. Golding Bird's pendulum break, exhibited to the London Electrical Society as far back as 1837, and described in "Sturgeon's Annals" (See the Ronalds Library). Retractile springs have been generally used instead of gravity, the introduction of which was due to Mr. Neef, of Frankfort, in 1839, and not, as is generally supposed, to Dr. Charles Page, of America. Another novelty is the commutator of Mr. De Watteville, by which a continuous current, or an intermittent current, or both combined, can be obtained from the same battery. Treatment by combined currents in this way is coming into practice in England, and is found advantageous in many cases where either a continuous or intermittent current, if used singly, would be inefficacious.

Mr. Thistleton also exhibits absolute and dead-beat galvanometers, graduated to show the current passing through the body in milliwebers. His rheostats for varying the current strength are remarkably inexpensive—one we saw containing 20,000 ohms in German silver wire, and divided into a number of different coils, costing only £1, a sum which may well surprise those who have purchased the more finely-graduated coils for electrical testing.

The same maker has also adapted the small chloride of silver element for surgical purposes. Each cell consists of a cake of fused chloride of silver tied to a strip of solid silver, and confronted with a plate of zinc, from which it is separated by folds of bibulous paper moistened with chloride of zinc solution. Each of these cells will, on an average, maintain a current for 800 hours through the living tissues.

There was also a fine specimen of Professor Bun's galvano-cautery, which is fitted with a trigger key, so that on being held in the hand the finger can make or break contact at will, thereby letting the current on or off. This is a convenient precaution, for the platinum wire should not be too hot, else it will draw blood; and, on the other hand, it should not, of course, be too cold, else it will not sear the flesh. A dull red heat is best, and this is kept up by regulating the current.

Besides a variety of coils and batteries, Mr. Thistleton exhibits a number of different electrodes for applying the current to the body. One of these is a flexible pewter electrode, which can be moulded to any part of the body. Another is a porous carbon electrode, which on being steeped in water acts better than a sponge, and does not shrink or shed its water. The most interesting of these electrodes is, however, one for applying static electricity from an electric machine. This kind of electricity is growing in favour among the Paris and London surgeons, especially in the treatment of hysteria. The electrode is attached to a glass handle, and the spark regulated by metal balls, one of which is adjustable by a screw, so as to widen or shorten the sparking distance. When a slow brush discharge is wanted, a sharp point is presented to the body; and when a spark discharge is wanted a ball is presented. Other electrodes exhibited were ingeniously fitted with a press button in the side to make or break the circuit.

A PIC-NIC.—On Saturday, July 16th, the members of the Engineering Department, N.W. District Postal Telegraphs of Manchester and the neighbourhood, went on their third annual pic-nic to Bucklow Hill, near Knutsford. Starting at 2 p.m. in a large break to the strains of a cornet, the party reached the Swan Hotel about 4 p.m., where a substantial tea had been provided. After doing justice to this portion of the day's programme, the party adjourned to the bowling green and gardens, while the tables were being cleared. The chair was then taken by Mr. Dohorty, superintending engineer, and the evening spent in toasting, speeches, &c. The party returned to Manchester about 11 p.m., having spent a very enjoyable day.

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THE ELECTRICIAN.

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CABLE INTERESTS.

Within the past few days several of the cable companies have held their half-yearly meetings, the commencement of the fight between the existing Atlantic Companies and Jay Gould is now seen, and the arrangement made public whereby Germany is to have direct cable communication with America.

The Chairman of the Eastern Telegraph Company (Mr. J. Pender, M.P.) had both good and bad news for the shareholders. He pointed out the admirable financial position of the Company, the increased receipts being largely due to the foresight of the management in taking so great an interest in the African cable, and thus the obtaining of an increased dividend while at the same time adding to the reserve. We have always looked upon the question of reserve as being a crucial one to test the position of any cable company. As was truly indicated at the meeting, the knowledge we possess of cable work is not yet sufficiently perfect to take such work out of the class generally termed hazardous; but the attendant risks are lessened with every increase of knowledge, no matter how obtained, whether from science or from practice. We as yet know far too little of the sea bed to enable us to say that this or that route is the best for cable laying. It may be that from sheer ignorance on this particular point a cable is laid in a dangerous position, when a slight deviation to the right or the left would have placed it in safety. The length of life of a well-made cable of good type is as little known as is the topography of the poles. When cables ten years or so old can be picked up and repaired in depths of 1,700 and 2,000 fathoms, it at once disposes of those alarmists who used to cry out, "But what if a fault appears in deep water?" Such faults have appeared, and yet the cables are at work as well as ever they were. The results of practice have completely dissipated these timid views. We are beginning to look upon a cable much in the same light as a railroad. There is a first heavy expense in building a railroad, and there is a first heavy expense in manufacturing and laying a cable. From the time of completion of either expenses in the shape of repairs are incurred; but we do not look upon a well conducted railroad after a lapse of ten or twenty years as in any other than a perfect condition. The proved ability to repair cables has made such undertakings far from dangerously speculative, and with the addition of a good reserve fund a well-managed cable company, catering for the public as well as its shareholders, and with sufficient but not undue competition, is one of the soundest investments with which the world is acquainted. The faults developed in the duplicate cables of the Eastern Telegraph Company are, we believe, of no serious character; but owing to the monsoon, and, consequently, the roughness of the surf, it is impossible for the moment to undertake the repairs. As soon as these winds moderate the cable staff will make temporary connection with the cables, and the Company's ss. "Chiltern" will early in September, the state of the weather permitting, lay two new shore ends.

Turning from the east to the west we notice that according to the daily papers Jay Gould's new cable will be ready for work on August 1st. Already, as we have previously indicated, the existing cable companies have issued notices that on and after the date just mentioned there will be a considerable reduction of tariff. Jay Gould is fighting for a huge stake. If he fails, as fail he may, he will simply follow the example of many an American millionaire who in the zenith of his wealth could risk his millions, but ere his business days were numbered could not command "tens" of pounds. "The latest act of Gould," so says the correspondent of the *Standard*, "is to render himself liable for the half-yearly dividends of the Western Union Telegraph Company, to the amount of two and a half million dollars."

There needs but little consideration to understand the present position of Atlantic telegraphy. The existing companies have agreements with the American lines. Will the laws of America allow existing agreements to be broken because a wealthy speculator determines in his own mind to reign supreme over telegraphic interests? Jay Gould may flatter himself that he can drive a coach and six through these agreements as easily as it is said that a similar vehicle can be driven through an Act of Parliament. But what if Jay Gould finds that these agreements cannot be ridden through? We fancy he will then find himself absolutely powerless, and to have embarked in a struggle that will be like the coil of a python, rather difficult to shake off. If the agreements are so much waste paper, he can only control a certain share of the business, and we must again point out that there is more than the amount of business and the rate per word or message to be considered. A cable, no matter of what type, no matter how perfect, with perfect instruments, will only carry a certain number of messages, and if it is fully employed at too low a rate, it must necessarily be an unprofitable investment. It is easy to know within certain limits the carrying capacity of any cable, and hence its earnings at any given rate. Its

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first cost, cost of maintenance, business expenses, &c., are also known or can be fairly estimated, and hence we can safely assert that Jay Gould's cable under existing conditions is not likely to be very remunerative. Further, the Anglo-American, and the Direct United States cables are duplexed, which gives them a still greater advantage. Again, the arrangement of the Anglo-American Company to give the Germans a cable direct will decrease the chance Gould has of obtaining Eastern-European telegrams.

One of the most satisfactory meetings of the week was that of the Western Brazilian Company, who were able not only to announce a substantial increase in their receipts, but to hold out some promise of a settlement of the law-suit, which has so long overshadowed the prospects of their property. It appears that a compromise, which the directors consider favourable to the Company, has been arrived at, and the shareholders having endorsed this view, we may look forward to a speedy termination of the dispute, and the formation of a satisfactory reserve fund.

THE CITY AND GUILDS OF LONDON INSTITUTE.

On Monday last the Prince of Wales, accompanied by the Princess of Wales, laid the foundation stone of the Central Institute to be erected under the auspices of the City and Guilds of London. The building has been designed by Mr. A. Waterhouse, A.R.A., and will be erected on a plot of ground granted by the Commissioners of the 1851 Exhibition, with a main entrance from the Exhibition-road, almost facing the Science Schools of South Kensington. The ceremony was performed under a large pavilion, tastefully decorated, before a large company, including many influential members of the City Corporation, the various guilds, and others interested in technical education.

The Lord Chancellor, in a somewhat lengthy address, described the conception and gradual realisation of the scheme for technical education of which the erection and maintenance of this building forms but a part. Among other things he said:—The Council and the Governors of the Institute have heard with unmixed satisfaction that your Royal Highness has graciously consented to become the President of this Association, the objects of which are the improvement of the industrial and commercial pursuits of this country, by affording facilities to apprentices, foremen, managers of works, and manufacturers, to become practically acquainted with the principles of science and art in their application to industrial operations. This useful institute of which your Royal Highness has consented to accept the presidency has grown up by the united efforts of a few of the ancient guilds of London, which, having combined for the purpose of assisting in the advancement of technical education, obtained later on the help of the Corporation of London and of other livery companies, 22 of which, including nine out of the 12 great guilds, are represented on the council of the institute, and jointly contribute nearly £21,000 annually to its funds. At first the efforts of this association were confined to the encouragement of technical education in schools and colleges in London and elsewhere, which needed pecuniary support to enable them to develop this special branch of instruction; and of these, University College and King's College, London, were among the first to receive grants towards the support of professorships of technical science and art. But latterly the institute has been enabled to establish and organise schools of its own for technical instruction, and also to assist in the development of technical education in a large number of towns in the United Kingdom. Pending the completion of the Finsbury College, instruction is being given to a large and increasing number of artisan students in some of the applications of chemical science to manufactures and industrial operations, and also in that new and widely opening field of labour and invention —the application of electrical science to the transmission and conservation of energy. Instruction will also be provided in that college, when finished, for those who are engaged in various handicraft trades, and it is hoped that this kind of teaching, which is gradually taking the place of apprenticeship in France, Germany, and Sweden, will help in this country to supplement, without supplanting workshop training. In Lambeth, the council of the institute have succeeded in founding a technical school of art, in which a number of male and female students are now receiving instruction in wood engraving, and in other branches of art, an aptitude for which is indispensable for success in all art industries. During the early part of the present year more than 80 evening classes were in operation, and it is satisfactory to know that the number of candidates recently examined by the institute in different branches of technology was 1,563, as compared with 816 in the previous year. But it is to the Central Institution, the first supporting pillar of which your Royal Highness has graciously consented to set this day, that the council look to crown their endeavours and give unanimity to all their efforts. The building, when completed, will be supplied with laboratories, in which the most delicate operations can be carried on, with workshops in which the various branches of mechanical and electrical engineering will be taught, with studios in which applied art may be practised, and with a lecture hall, theatres, and class rooms in which the principles of science will be explained. It gives me great pleasure to be enabled to add that it has seemed fit to Her Majesty to recognise on this occasion the eminent services of Mr. Bramwell, the indefatigable chairman of the executive committee of the institution, by signifying Her Majesty's gracious intention of conferring upon that gentleman the honour of knighthood. It is anticipated that the cost of this building, when fully equipped with the apparatus and appliances needful for technical instruction, will not fall far short of £75,000. Of this sum £31,000 has been already subscribed by the worshipful companies of Fishmongers, Goldsmiths, Clothworkers, and Cordwainers (the grant of the Drapers' Company having been appropriated to the Finsbury College), and it is expected that about £24,000 will be saved from the annual income of the institute during the building of this college. The Council, therefore, after paying the amount which is due, will have at their disposal only an estimated sum of about £55,000, and they look to the liberality of the Livery Companies, both of those who have and of those who have not as yet subscribed to the funds of the institute, to make good the balance of £20,000, so that the building of this college may be completed at once and as a whole, in strict accordance with the plans.

His Royal Highness the Prince of Wales then said: My Lord Chancellor, my Lords, Ladies, and Gentlemen: I thank you for your address, and beg leave to assure you that it gives me much satisfaction to attend here to-day to lay the foundation stone of an institution which gives such forcible expression to one of the most important needs in the education of persons who are destined to take part in the productive history of this country. Hitherto English teaching has chiefly relied on training the intellectual faculties, so as to adapt men to apply their intelligence in any occupation of life to which they may be called; and this general discipline of the mind has, on the whole, been found sufficient until recent times; but during the last thirty years the competition of other nations, even in manufactures, which once were exclusively carried on in this kingdom has been very severe. Both in Europe and in America technical colleges for teaching, not the practice, but the principles of science and art involved in particular industries, had been organised in all the leading centres of industry. England is now thoroughly aware of the necessity for supplementing her educational institutions by colleges of a like nature. Most of our great manufacturing towns have either started or have already erected their colleges of science and art. In only a few instances, however, have they become developed into schools for systematic technical instruction. This building, which is to be erected by the City and Guilds of London, will be of considerable benefit to the whole kingdom, not only as an example of an institute devoting itself to technical training, but as a focus likewise for uniting the different technical schools of the

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metropolis already in existence, and as a central establishment also to which promising students from the provinces may, by the aid of scholarships, be brought to benefit by the superior instruction which London can command. Allow me, in conclusion, to express the great satisfaction which I experience in seeing the ancient guilds of the City of London so warmly co-operating in the advancement of technical instruction. By consenting at your request to become the president of this institute I hope it may be in my power to benefit the good work, and that our joint exertions, aided, I trust, by the continued liberality of the City and Guilds of London, may prove to be an example to the rest of the country to train the intelligence of industrial communities, so that, with the increasing competition of the world, England may retain her proud pre-eminence as a manufacturing nation.

EASTERN TELEGRAPH COMPANY (LIMITED).

The eighteenth half-yearly ordinary general meeting of the Eastern Telegraph Company (Limited) was held on Thursday, the 14th July, 1881, at the City Terminus Hotel, Cannon-street, London, under the presidency of John Pender, Esq., M.P.

The SECRETARY having read the notice convening the meeting, and the minutes of the last meeting, held on 27th January, 1881, which were duly confirmed,

The CHAIRMAN said: Gentlemen, I may merely mention briefly that our revenue for the six months ended March 31st, 1881, amounted to £302.158, against £291,194 in the corresponding period of last year, being an increase of £10,964. This increase is to some extent accounted for by the improved return on our investment in the South African Company. The South African Company has paid a dividend at the rate of six per cent. and a bonus of four per cent. per annum, against a dividend of six per cent. last year. As to this Company's expenses, the ordinary expenses amounted to £67,754, against in the corresponding period of 1880 £68.637, or a decrease of £883. However, there is included in last half year's charges £1,054 for the staff insurance fund, £413 for the duplex apparatus, and £69 for bad debts, which did not appear in 1880. I have in my hand, gentlemen, a very detailed statement of all the items connected with the increases and decreases, but having stated briefly the differences, I don't think it is necessary to go into further detail to-day; but if there is any question on any particular point in the report you wish to put to the chair, I should only be too happy to answer it. As you are aware the accounts are very clear, and almost every item of importance is stated therein, so that you have before you sufficient data to form a judgment. I have generally on these occasions been able to congratulate you that our cables were in perfect working order. I am sorry to say to-day that our two Bombay cables are not in good working order, in fact, both are silent; but from the information we have, we believe they are interrupted within a very short distance from the shore, and taking advantage of the very first lull in the monsoon, we shall be able to repair these cables and set them at work again. Therefore, beyond the delay in the traffic, it does not cause any uneasiness to your directors. However, the result of our being able to carry on traffic has arisen from the arrangements which your board were able to make some time ago, not only with the Indian land line system, but also with the Government system of Indian telegraphs; so we are now carrying on our traffic in that direction without any serious sacrifice of revenue on the shareholders' part. These combinations, gentlemen, are almost a necessity in submarine telegraphy, because after all (and I have never hesitated to tell you so on these occasions) submarine telegraphy is more or less a speculative investment. We know that the cable is at the bottom of the sea, but we don't know on what ground. If we could place it at the bottom of the sea on a platform such as this table we know that the cable might live for an indefinite period. We are, however, uncertain what the bottom of the sea is; but there is one satisfaction—that in the last ten days a cable laid 11 or 12 years since from Brest to St. Pierre was repaired the other day, and is now in good working order. I think it was brought up from something like 1,700 fathoms water. We also in May last repaired a cable from 2,000 fathoms water, so that while on the one hand we may call it more or less speculative, on the other hand, our experience is leading us to a knowledge which gives us what we may call a fair property. Gentlemen, in this hot weather I think it would be almost wrong to detain you very long. I could go into very great detail to show you something of the progress of this Company from the commencement. Repairs, as you are aware, form a large item, but when we take the repairs from the commencement they appear to be something under 10 per cent. of revenue. I might also go on to show you the proportions of the working expenses at very great length by the details which I have prepared, but which I may probably put before you on another occasion. At present I have to congratulate you so far that we are able to pay you some little addition to our dividend, and I hope that that addition may be still further increased. But to enable you to earn a steady dividend, and to give your property something like a good footing in the general market, we think it most important that we should add to our reserve fund. In the earlier stages of this Company we were not in a position to add largely to the reserve fund, and although we have added £70,000 this last year, the average since the commencement of the Company has been £41,000 a year applied to that fund. We feel now that we are getting fairly represented in our reserve fund, but we don't feel yet that we have got sufficient to say that we are perfectly independent. I, therefore, trust that the policy of adding largely to the reserve, and gradually and steadily, I hope, increasing the dividend (giving a proportion of the good that comes out of the concern to the shareholders, and, on the other hand, also adding to the value of their property by increasing the reserve fund) will meet with the approval of the large body of our shareholders [hear, hear]. With these remarks I beg to move this resolution:—"That the printed report and accounts of the directors to 31st March, 1881, submitted to this meeting, be and they are hereby received and adopted; that a dividend on the preference shares of the Company to 30th June, 1881, at the rate of 6 per cent. per annum be paid, less income-tax; and that, in accordance with the directors' recommendation, a dividend be and is now declared of 2s. 6d. per share, with a bonus of 1s. per share (both free of income-tax) on the ordinary shares of the Company, making, with previous payments by way of dividend on account, a total payment of 5½ per cent. on these shares for the year ended 31st March, 1881."

The VICE-CHAIRMAN (the Marquis of Tweeddale): I beg to second that motion.

Mr. STOKES: As a new shareholder I should like to know what your idea of a reserve fund is—to what extent would you think of increasing it? It has gone on it seems very satisfactorily, and the investment of the reserve fund is most satisfactory indeed [hear, hear]. I should suppose your notion is about £500,000. If that is your idea I think that would be a very respectable sum, and we might look forward to a little increase in our dividend.

Mr. WEIR: I am very glad to find such a satisfactory report to-day. I am also equally gratified at finding you have invested your money in such good solid securities as the list shows us. With regard to the breakages you mentioned, can you state what is the approximate estimate of the cost of the repairs, and, as to your continuing to add to the reserve fund, what is your idea of a maximum reserve?

Mr. HIRST: I am convinced that this report must be very satisfactory to the shareholders, and it is especially satisfactory because we find that the idea which was shadowed forth by the chairman at a previous meeting has this time been realised, and that we have an addition to our dividend by the bonus added. With regard to the reserve fund, this addition to the reserve fund is also very satisfactory. It is the system we ought to go on to give a greater security to our investment. The chairman has stated, of course, that it is purely speculative, but I conceive from his statement altogether that this Company is getting less and less speculative. In the first instance, of course, it must have been so, but the directors are now every year gaining additional experience, and can form some kind of approximation as to what the probable expense may be in the future; and as they are every day and every half year increasing the reserve fund, even if a great calamity should occur, we should be fully prepared to meet it. Taking it altogether, gentlemen, I think if we go on in the way we have done I have that confidence in the directors, having watched them for many years—I have the greatest possible confidence in them and in this policy of increasing the reserve fund, and more especially because they do not boast much of it. Their additional experience of telegraphy will enable them to make some fair calculation of what the result of the future will be; and therefore I think that, so far from our Company in the future being merely speculative, it will become more and more firmly established every year. I have great pleasure in congratulating you that we are still going on with an addition to our dividend this time, and I am still further gratified by the chairman holding forth the hope that we shall have an additional dividend in the future.

Mr. HUNTER: Will the chairman kindly inform us when the debentures on which 6 per cent. is being paid mature, and if the attention of the board has ever been called to the formation of a 4½ per cent. debenture stock to redeem those debentures as they mature?

The CHAIRMAN: Gentlemen, I think I gather from the remarks made by the shareholders who have spoken a general approval of the report which is submitted to you to-day [hear, hear], and I am therefore the more glad to answer the one or two points referred to. First, Mr. Stokes asked what is the board's idea of a reserve fund. Well, gentlemen, that depends entirely upon the experience that we gather from year to year as to the state of our cables. If we find that our cables are repairable after ten or twelve years we may tell you that we can do with a smaller reserve fund, but if we find that our cables are decaying faster than we expected, we shall naturally ask you for a larger reserve fund. Therefore, to state any particular amount I think would be misleading you, but we will tell you every half year our opinion of your property, and then you will be as able to judge as we are as to whether it is desirable or not to continue adding largely to the reserve fund. Mr. Weir also, I think, generally approved the report, but he says he has had only six days to consider it. I believe, however, that the reports were posted perfectly within the time, but if I may judge of the number of prospectuses and one thing and another that I am receiving every morning, I have some sympathy with the Post Office if they are not quite as ready and as early in delivering as they generally are. That is the only excuse I can make Mr. Weir for the delay. Mr. Hirst gives us general approval. I hope sincerely that the confidence he places in the directors will be realised in something practical when we meet from half year to half year. Mr. Hunter asks about the debentures. I think if Mr. Hunter refers to the report he will see when those debentures expire. They expire in 1883, but he has suggested what has been under the consideration of the directors for some little time, and that is to see whether by and bye we may not be able to replace our present debentures by debentures at a very much lower rate [hear, hear]. If the present state of the money market continues I think there is no doubt that we shall be able to do it; but depend on it we shall do it much more readily when we have a considerable addition to our reserve fund. All that is now under the consideration of the board. You can well understand, as to debentures falling due from time to time, that those who have good debentures are not disposed to part with them unless they have a *quid pro quo*; and I hope we shall arrive at some scheme that will be satisfactory to the debenture holders and beneficial to the Company's interests. Another question was as to when the Bombay cable would be repaired. Sir James Anderson has just put a note into my hand stating that the breakage is within four miles from the shore, and you may understand from this that it only requires a day or two of fine weather to repair it. As to the extent of the repair, maybe we shall replace some of the chafed cable with new shore cable; but that the cable will be repaired immediately we are not under the slightest apprehension.

A SHAREHOLDER: Of course you cannot mention the approximate cost?

The CHAIRMAN: I should think the shore end will be something like £5,000.

Mr. JOHN NEWTON: As to the breakage, I should like to make one remark. I think you have never yet had a break but what you have repaired it very speedily. We have had no prolonged breakage, and have

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never had one but what it has been repaired, no matter what depth it was. I think that is an important fact if it is the truth.

Sir JAMES ANDERSON: Yes.

Mr. NEWTON: It shows the permanence and stability of our property.

The CHAIRMAN: What Mr. Newton has stated is perfectly true ever since the formation of the Company. I remember well when the first cable was laid there was a belief that it would be impossible to repair it. That idea has entirely passed away, and every year experience teaches us that from almost any depth of water we can repair a cable, and that it is only a question of time. If in shallow water, the repairing ship does it at once, while if in deep water, it may be delayed for a time, but eventually it is done. Therefore, it is quite true, as Mr. Newton says, it is only a matter of time, and not a matter giving any real cause for depreciating your property; and our arrangements at the present moment with other companies place us in a position of having time to repair our cables without any great loss of income being sustained by us. Those in favour of the resolution will please to hold up their hands. To the contrary. Carried unanimously. We have nothing more to put before you to-day. I will only just say before you leave that we are closely watching your interests. We have a direct line through France in connection with our cables to Egypt, which has proved very beneficial to us. We had to pay something for it, which I stated to the shareholders when it was done, but it has proved a very useful arrangement for the Company. We expect before long to have another direct line through another important part of Europe, thereby giving us a stronger hold on the telegraph system, and giving greater permanence to those interested in it.

Dr. WALLER: Gentlemen, I have a duty to perform which if not difficult is certainly very pleasing, and that is to move the very best thanks of this meeting to our able and excellent chairman and his brother directors. Sir, this resolution so commends itself to every one here present, and is so well buoyed up by the admirable and cheering report before us, that I anticipate nothing but a hearty and unanimous response to my proposal. We have had from you, sir, what I should venture to call a very witty speech indeed. I call it witty in the very best sense of the word, because brevity is the very soul of wit; and it was not only very witty in that sense, but I think a very wise speech, and not only a very wise but a very cheering speech. You have cleared up any difficulties which we might have felt on the sudden announcement of the cable being broken, that we might look on it as being a very trifling matter. In fact, as was observed by you about speculation, the more we get to know it the less speculative it becomes, and we shall soon arrive at certainty, and shall be prepared to hear that there is no breakage. How we shall bear such a statement as that I don't know—it will be very monotonous. I would also take leave to make an addition to the resolution—to couple it with our best thanks to the most excellent and efficient officers who belong to this Company. We all know that the rank and file and non-commissioned officers often do a great deal of hard work which the gentlemen in the higher stations benefit by. I shall now conclude by heartily recommending this resolution to the meeting.

Mr. STOKES: I have great pleasure in seconding it.

The CHAIRMAN: I thank you very heartily for the very kind way you have passed this vote of thanks to the chairman and directors. We are all most anxious to give the fullest information, and do all that we can for the Company. I believe we have a staff second to no staff in any department of business in the world. I was never more gratified than the other day when the late Lord of the Admiralty, who last year visited many of our stations in the Levant, said that the staff did honour to England and would do honour to any company who had such officers under their control. I believe that the system of telegraphy requires intelligent and honourable men, and I believe that we have got intelligent and honourable men in our service. I beg to thank you.

Mr. WEIR: I am quite out of order in asking such a question, but perhaps you will give the information. Is the Oriental Telephone Company likely to develop our business?

The CHAIRMAN: I am very glad you have put that question, because my name is associated with that company.

Mr. WEIR: I know that you are the distinguished chairman of it.

The CHAIRMAN: I wish you to understand why I associated my name with that company. The telegraph companies over which I preside have important interests in India, and the telephone system I believe must eventually be a feeder to the telegraph system, as the former supplies a want for short distances which cannot so well be supplied by the telegraph. If the Oriental telephone system had fallen into the hands of people opposed to telegraphs it might have caused us some trouble. It was for that reason, and not from any desire on my part for additional labour, that I associated my name with the Oriental Telephone Company, believing that I should thus benefit the interests I represent in the telegraph companies, and at the same time promote the growth of the telephone system.

Mr. WEIR: I am very pleased to hear that from such a distinguished authority as yourself—that the Oriental Telephone Company is likely to be a feeder to our Eastern Telegraph Company.—The proceedings then terminated.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY (LIMITED).

In accordance with the resolution of the general meeting of 28th February, 1871, a half-yearly general meeting of the Telegraph Construction and Maintenance Company (Limited), was held at the offices, 38, Old Broad-street, on the 19th inst., under the presidency of Sir D. Gooch, Bart., M.P.

The SECRETARY (Mr. W. Shuter), having read the notice convening the meeting, as above,

The CHAIRMAN said: Gentlemen, these meetings, I am afraid, are not very useful—we bring you here for very little information, and have no accounts or report to put before you. However, it was your wish that we should have these meetings, principally with the view to enable you to ask any questions you desired to put respecting the half year's working. During the past half year we have not had very much in hand. We have only made a couple of hundred miles of cable, but we have also chartered two of our ships. One was chartered to the Government and went to the Cape with troops, and I believe she gave satisfaction to the authorities. Another one was chartered for some cable work. The "Scotia," as you are aware, no doubt, has recently returned from repairing the Brest cable of the Anglo-American Company, which she succeeded in doing, and it is now in efficient working condition. On the occasion of going last year the enterprise failed in consequence of the extremely bad weather, and the vessel was obliged to come home, leaving the work uncompleted. She went out again this year, and did the work satisfactorily. The cable was raised from 1,700 fathoms, and a new piece of cable was put in where it was broken. What may turn up during the course of the year we cannot say. We are looking out and doing the best we can to obtain work, but no doubt there is a lull at the present moment in cable work, and we must only hope that something will turn up to give us employment, as on that depends our success. If any shareholder has any question which he wishes to ask I shall be very glad to answer him. I am afraid I have nothing to tell you beyond what I have said.

Mr. WILLIAM ABBOTT: At the last meeting I alluded to the development of the electric light, and there is no doubt that electricity is about to be developed in various other ways beside lighting. Are you giving your attention to the subject? I would ask you whether it would not be possible, using your great influence, the valuable staff of electricians you have, and the large available cash resources which you enjoy, to ally yourselves with some of these electric light companies or electrical inventions, so as to fill up the void when cable work is slack? There is not the slightest doubt—we see it on all sides—that the Americans are coming over here with their notions of electricity, and they seem leaving us in the ruck. I do not see why this Company should not identify itself with some other work besides cable manufacture, making it an adjunct to cable work, in which we are supreme.

The CHAIRMAN: The matter is not forgotten by the board, for we are now making covered wires for the electric light, and when I was at the works the other day that was the principal work that was going on. The electric light has become, and I hope will become to a much greater extent, almost universal in our large buildings. We use it at the Great Western Railway at our passenger station. No doubt it is only just beginning to be used for such large buildings as railway stations.

Mr. ABBOTT: And warehouses.

The CHAIRMAN: It covers a large area with light. It will entail the use of a good deal of covered wire in connection with the machinery. They at first used very inferior wire, which I do not know who made, and it did not answer. We are now covering the wires for them.

Mr. ABBOTT: I think if this half-yearly meeting did nothing else than bring out such an announcement, it would be eminently satisfactory. I raised this question when you were here at the last half-yearly meeting, and now you see the result that we have from it. I do not for a moment take credit to myself in the matter, for I know that you are thoroughly alive to availing yourself of everything of the kind. I quite agree with you that we are on the eve of a great revolution in the science of electricity. At all the ironworks in Wales the electric light is coming into use. A mistake was made at first in covering the wires in a rude fashion, and they have suffered through that; but they have now become alive to the importance of a better covering.

A SHAREHOLDER asked what dividend was going to be paid.

The CHAIRMAN: The usual interim dividend of 12s.

A SHAREHOLDER inquired whether danger was not to be feared by the Company from competing lines. A line had lately been made and laid down by Jay Gould—the French line. He wanted to know if they were prepared to meet any difficulties of that kind?

The CHAIRMAN: The new line you speak of is a line not made by Jay Gould, but a line the capital for which was found by Jay Gould. The line itself was made by Messrs. Siemens, of England, who have made other lines—who made the Direct Cable and the last French line. I have no doubt that they compete with us, and that we have their competition. We have, however, had the competition of Messrs. Siemens for several years past, and no doubt we shall in future have their competition; but we must be prepared to meet it as best we can. We are not afraid of our quality.

The SHAREHOLDER replied that that was all that he wanted to know.

A vote of thanks to the chairman and directors then terminated the proceedings.

GERMAN UNION TELEGRAPH AND TRUST COMPANY (LIMITED).

An extraordinary general meeting of the members of this Company was held at the offices of the Company, 66, Old Broad-street, on the 18th inst., "for the purpose of considering proposals of the German Union Telegraph Company of Berlin for establishing a new cable between Germany and Ireland, and raising capital for the purpose by the issue of preference shares, and passing such resolutions with respect thereto as the meeting may deem expedient." Sir James Anderson presided.

Mr. W. PAYTON, the secretary, having read the notice convening the meeting,

The CHAIRMAN said that they had heard the object of the meeting. He thought that the principal points were these. The German Government, and their telegraphic administration especially, were desirous of having direct communication with America, and the German Union Company had undertaken to lay a cable connecting Germany with Valentia, and thence to America by one of the Anglo-American Company's cables. The concession which is offered to the German Union Company contains some clauses which gave them the preference of laying any further cables which might be required to meet the wants of Germany. It would also give the German Union Company a duplicate cable. The board of the Trust Company concurred with the directors of the German Union Company in Berlin in laying this cable and securing themselves from opposition. It was not a cable which they could allow to get into anyone else's hands. To make the thing as efficient as possible, an agreement had been entered into with the Anglo-American Company, by which they would work the cable from Valentia to America, and for all purposes Germany would have by the new cable as direct communication to America as was enjoyed by France and England. No doubt the new cable would affect the ordinary shares, but not so much as a rival cable would. Probably they were not aware that the founders of the original Company had the right to a full half of the new shares, and if they took them, which it was assumed they would, then the shareholders of the present Company would be allowed to apply

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for the other half *pro rata*. The directors of this Company considered the investment a fair one, and one likely to meet with the approval of the shareholders and be taken up by them. The original capital of the Company was £165,000, and it was proposed to take powers to raise £165,000 in Five and a-Half per Cent. Preference Shares, which the shareholders would have the right to take among themselves in the above proportions.

Mr. DUNPHY asked how it was proposed to pay up the new shares—in what instalments.

The CHAIRMAN replied that that would be announced afterwards. They wished to give the Berlin directors power to close the negotiations, and to carry out the proposal, and then they would decide how the capital should be paid up.

Mr. DUNPHY said that the circular seemed to imply that the object of the new cable was to get Irish traffic.

The CHAIRMAN replied that that was not the object. It was really meant for American traffic, and arrangements had been made by which the Anglo-American Company conceded a good deal to make it profitable.

Mr. DUNPHY asked how messages were ordinarily sent from Germany to America.

The CHAIRMAN: They come from Emden to Lowestoft, then to London, then to Valentia, and so to America. The idea of the present proposal is to give Germany direct communication to America through Valentia.

Mr. DUNPHY inquired whether any estimate had been formed of the comparative advantage of the present and the proposed system of communication.

The CHAIRMAN stated that the advantage was such that either the German Union would have to do it or it would be done by some one else. He might explain that there were four wires in the present cable, and there would be one in the new. Three of the wires were reserved, and were used for Continental traffic. The new cable would be heavy, especially in that part of the Channel where fishermen dredged, although they knew pretty well how to avoid that.

Mr. DUNPHY asked if the difference in cost would be very great to have two wires instead of only one in the new cable.

The CHAIRMAN, in reply, said that it would be a large difference. It would make not only the core much dearer, but the external covering much more costly. Nor were two wires necessary, as one would be amply sufficient to carry all the German traffic to America. It must be kept for American traffic. They could send London messages by it, but they would first have to go to Germany.

Mr. W. FORD: It is an alternative route in case of breakage.

The CHAIRMAN: Yes. He then moved the following resolution:—"That this meeting having considered the proposals of the German Union Telegraph Company of Berlin, with respect to the laying of a new cable between Germany and Valentia, and the chairman's explanation in regard thereto, it is hereby resolved that such proposals be generally approved, and that the directors of this Company be authorised to communicate this resolution to the Berlin Company, and to make such arrangements with that company with respect to the issue of the new shares as they make think expedient, and to procure for the shareholders of this Company the opportunity of subscribing for such of the new shares of the Berlin Company as they shall be entitled to in respect of their holdings in this Company."

Mr. PENDER, M.P.: I suppose that the real object of this new cable is to give to Germany what you may call a line of their own, just as the French have?

The CHAIRMAN stated that he had already explained that that was so. It would give as direct a line to America from Germany as could be made.

Count OSCAR REICHENBACH (a director) seconded the motion, and it was carried unanimously.

The CHAIRMAN then stated that as soon as the affair was matured, and everything arranged—how the capital was to be raised, and the agreement with the German Government fairly concluded—they would issue a circular to the shareholders, and intimate how the capital was wanted.

Mr. PENDER inquired if the new capital would be a first charge, or rank with the existing capital *pari passu*.

The CHAIRMAN replied that it would be a first charge on the whole revenue—a preferential 5½ per cent. In reply to Mr. Dunphy, he added that they had formed an estimate as to the effect it would produce on the old shares, but it was a mere estimate, and would depend on what the traffic would give.

Mr. DUNPHY asked if the German traffic to the United States passed through France or England.

The CHAIRMAN stated that it came through England, but it would pass over the proposed new cable when it was laid, so that instead of paying the Post Office they would pay the new cable. No Act of Parliament would be required.

Mr. BURT added that a license would have to be granted by the Board of Trade to land at Ireland. That had been applied for, and they had no reason to doubt that it would be granted in the usual way.

Mr. WEAVER, in reply to another question by Mr. Dunphy, said that the cost of the new cable would be under the estimate of £165,000.

On the motion of Mr. PENDER, seconded by Mr. FORD, a vote of thanks was passed to the chairman and directors, and the meeting then terminated.

CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).

The 20th ordinary general meeting of this Company was held on the 20th inst., at the offices, Old Broad-street, E.C., under the presidency of Mr. T. Hughes, Q.C.

The SECRETARY (Mr. James Scott) having read the notice convening the meeting,

The CHAIRMAN said he thought they would agree that the accounts were satisfactory in several ways. They had been able to carry to the reserve fund £3,750 out of the earnings of the past half year. The traffic receipts had not been quite so favourable as they were in the previous half-year, partly owing to the increased habit of using code systems; and on the other hand their neighbours had unfortunately again had several faults in their cables. On the whole the traffic receipts gave a satisfactory proof that the Company was continuing to maintain the success of its previous career. The shareholders would be glad to learn that the proposal before them at the last half yearly meeting had been satisfactorily carried out. The new cable had been made by Messrs. Hoopers, and was in excellent condition, and had given every satisfaction since it was laid down. A fixed payment had been arranged for the cable, so that the risk of large sums being charged in future would not recur again, and they would know precisely how they stood with regard to the cost of maintaining the cables. The law charges were considerable. There was a sum of £185 for the half year, but the explanation was that they had had a suit at Havanna, and so far as could be done in the colony they had recovered the sums which had been levied wrongly by the authorities for their Santiago business, but there was an appeal to Madrid. However, in that they had every chance of being successful. In that event they would realise a sum of about £1,000. The state of the island was more satisfactory than it was, but that unfortunately told rather against them, because it induced the use of the land lines more than would otherwise be the case, and to a certain extent depreciated their traffic; but the regularity and certainty with which the Company's traffic was conducted told against the land lines, and they trusted in future that this was likely to sustain their advantage over them. He should be glad to give the shareholders every information in his power concerning the balance sheet, but he thought there was only one item to which he need refer. The miscellaneous expenses had increased to a certain extent, chiefly owing to an increase in the salary of their excellent manager out there, Mr. Keith, who certainly deserved everything they could do to acknowledge the great ability with which he had served the Company. He thought that that gentleman would compare with any telegraph engineer for the ability and certainty of his work. He concluded by moving the adoption of the report and accounts.

Mr. HORATIO J. PERRY seconded the motion.

Mr. STOKES asked the number of years the proportionate payment would extend over for the new cable.

The CHAIRMAN replied that the amount was paid half yearly, and would extend over a period of 12 years. It would eventually become the property of the Company.

Mr. STOKES thought that the explanation was highly satisfactory. He considered that the accounts showed the stability of the Company.

A SHAREHOLDER asked the amount they received as interest on their investment?

The CHAIRMAN: About 5 per cent.

Mr. WEIR regarded the report as very satisfactory. He considered it was very advantageous that a Company should have a good reserve, and theirs amounted to about 20 per cent. of the capital.

The CHAIRMAN, in reply to a Shareholder, said that no proposals had been laid before them by Mr. Jay Gould respecting the Company's undertaking.

Mr. GRIFFITH alluded to the amount of the reserve fund, and asked whether the contractors would be willing to at once take the price down for the new cable at a discount. He thought if they would do so it would be an advantage to the Company. He imagined that at the end of 12 years the cable would not be worth much, as it must, he thought, be worn out in that time. He testified to the admirable management of the Company.

The CHAIRMAN, in reply, stated that the contractors were bound to keep up the cable during the whole of the 12 years, whereas if the Company paid the money down at once, the repairs would fall upon themselves. The resolution was then put to the meeting and carried, and dividends were afterwards declared at the rate of 7 per cent. on the ordinary shares, and at the rate of 10 per cent. on the preference shares. The retiring director and auditor were next re-elected.

On the motion of Mr. STOKES, seconded by Mr. KELLER, a vote of thanks to the chairman and directors was passed.

The CHAIRMAN acknowledged the compliment, and the proceedings then terminated.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY (LIMITED).

The eighth ordinary annual general meeting of this Company was held on the 20th inst., at the Cannon-street Hotel, under the presidency of Sir Henry Drummond Wolff, G.C.M.G., K.C.B., M.P., the Chairman of the Company.

The SECRETARY (Mr. R. M. Cunningham) read the notice convening the meeting, and the report of the directors, which has been published in *The Electrician*, was taken as read.

The CHAIRMAN said he would first make some remarks on the first report, which was issued some time ago. At the time they were informed that, for the reasons which he believed they generally approved, they would postpone the ordinary meeting of the Company until that moment. They would be gratified to know that the traffic of the Company had been increasing slowly, but at the same time with a regular precision, and at the present moment, by the most recent traffic returns, the past 41 weeks showed a balance over the receipts of a similar period last year of £4,858. In fact the receipts were gradually amounting to a sum which, unless some accident occurred between now and October, would warrant the directors in declaring a small dividend, especially if they had a substantial reserve, as he hoped they might have by that time. He would not dwell very much on the general features of the report, inasmuch as when the report was issued they were informed that any additional information could be obtained by application at the office. There had been very few applications, but he supposed that any question that would have been asked by that time had been asked, and he should be glad afterwards to give them any information they might require with regard to any details of the report. He might, however, now come to what he considered—and he believed they would also consider—the most important object of their meeting that day, which was to confirm, if the meeting should think fit, or reject the offer of compromise made to them with regard to a large stake they had in a suit now pending before the Court of Chancery. He might say that the directors might legally, under their powers, have accepted the compromise without reference to the shareholders, but although the statutes conferred on them that power, yet as the claims they had were really concerning rather the inception of the Company than its actual progress since it was formed, and as the subject was of such capital importance to the Company, they considered it their duty to summon the shareholders together, and to submit the compromise to them. He must say that the directors, though not doubting the strength of their case, had, under the advice of counsel—the same counsel who had advised them all through—considered it their duty to

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recommend to them the acceptance of the offer which had been made to them. As to their reasons for this, they had, as he had just intimated, a great necessity for establishing a good and substantial reserve, and they thought that by accepting that proposal they would at once carry out that object; but independently of that, however strong their case might be, they considered, as men of the world, and having some knowledge of business—and he hoped the shareholders would agree with them—that it was more advisable to accept a compromise than to trust to the chances of a lawsuit, which must necessarily be long delayed, and lawsuits were always open to certain chances which not even the wisest counsel could foresee. If they had gone on with the suit, which had been delayed in a great measure owing to certain vacancies on the judicial bench, it was doubtful whether they would have got a judgment, even in the first instance, that year, and it might be held over by appeals for perhaps two years longer. Meanwhile they had offered to them a very substantial sum, which would place them not only in a position of financial credit and soundness, but would also enable them to have their minds clear to carry on certain important negotiations with the Brazilian Government, and he might add that they had just received a telegram from Brazil which gave them great expectations that those negotiations would be successfully carried out. He would respectfully deprecate any discussion of the merits of the lawsuit. In the first place it was at that moment *sub judice*—it was before the Court; and he really had very good reason for saying that if the lawsuit went on—he had it from a great legal authority—and there was any discussion of the merits of the suit at the meeting, although it might not be deemed contempt of court, yet it would be very badly looked upon by the Court when the subject was brought before it. The essence of compromise was, generally speaking, the sum that was to be received; and if the shareholders were satisfied with the sum that was proposed as one which the directors and the Company could conscientiously accept in termination of a long and complicated lawsuit, brought by the Company several years after the occurrences to which it referred, and involving a very large number of defendants, he would venture to submit to them that it would be wiser for them to express their opinion in that respect—as to the amount of the compromise, and as to the advisability of their accepting it—rather than go into a discussion which would be almost interminable, and which he thought would be most damaging to the prospects of the Company. He did not think it was necessary to detain them any longer, as they knew all the circumstances as well as he did. He concluded by moving the adoption of the report and balance-sheet to the 30th September, 1880.

Mr. W. S. ANDREWS having seconded the motion,

The CHAIRMAN expressed his readiness to answer any question; but no shareholder rising, he put the motion, and it was carried unanimously. He next moved the following resolution:—"That the Company in general meeting hereby approves of the directors compromising the actions referred to in the report submitted to this meeting, on the basis stated in general terms in the supplementary report dated July 12, 1881, with such modifications or alterations and provisions, not affecting the net results to the Company, as the directors may deem expedient and the nature of the arrangement may require."

Mr. D. H. GOODSALL having seconded the motion,

Mr. PRANCE, while deprecating any discussion of the matter, asked the amount involved that was outstanding.

Mr. KENDALL thought the matter had been so admirably arranged that it should be left in the hands of the directors.

The CHAIRMAN, in reply, stated that the number of defendants who had not come into the arrangement was very small, and from recent intelligence he was happy to say that he thought they would be all likely to come into it. He could not go into figures, but the outstanding claims were not large; they would add something, but not very much, to the amount the Company were to receive. The resolution was then put and carried unanimously, and the retiring directors and auditors were subsequently re-elected.

Captain AYLMER moved a vote of thanks to the chairman and directors, and spoke in high terms of the efficient manner in which the negotiations had been carried out.

The motion was seconded and carried unanimously, and the meeting then separated.

ELECTRIC LIGHT AND POWER GENERATOR COMPANY (LIMITED).

An extraordinary general meeting of this Company was held on the 20th inst. at the works of the Company, Bankside.

Admiral Sir E. A. INGLEFIELD, C.B., D.C.L., F.R.S., presided, and moved the confirmation of the special resolution altering the Articles of Association of the Company which was passed at the meeting of the Company on the 5th inst., and published *in extenso* in *The Electrician* of the 9th inst.

The motion was seconded and carried unanimously.

An inspection of the works was afterwards made, and satisfaction was expressed at what was seen.

INDIA RUBBER, GUTTA PERCHA, AND TELEGRAPH WORKS COMPANY (LIMITED).

The half-yearly general meeting of this Company was held on the 21st inst. at the Cannon-street Hotel, Mr. George Henderson in the chair.

The SECRETARY (Mr. Wm. J. Tyler) having read the notice convening the meeting,

The CHAIRMAN said: Gentlemen—This is merely a formal meeting to obtain your sanction to an interim dividend, and we are very pleased at having it in our power to pay this dividend from fairly earned money. The general business of the Company is going on in a very satisfactory manner, but orders for cables have been slack during the half year. I have really nothing more to say to-day, and therefore I will move the resolution that an interim dividend of 10s. per share, free of income-tax, being at the rate of 10 per cent. per annum, payable on and after the 22nd inst., be now declared.

Mr. S. W. SILVER seconded the motion, which was carried unanimously.

A SHAREHOLDER proposed a vote of thanks to the chairman, and said that it was gratifying to hear that the Company was going on satisfactorily, though it was not satisfactory to hear that orders for cables were falling off. He presumed that was only temporary.

The CHAIRMAN: It is only temporary.

Mr. HUME seconded the motion, which was put and carried *nem. con.*

The CHAIRMAN: We are very much obliged to you for the kind vote. We will do our best to make the Company pay.

The proceedings then terminated.

DIRECT UNITED STATES CABLE COMPANY (LIMITED).

Report of the directors of the Direct United States Cable Company (Limited) for the six months ending the 30th June, 1881, to be presented at the eighth ordinary general meeting of the Company, to be held at the Cannon-street Hotel on Thursday, the 28th inst.:—With this report the directors submit the usual statements of account for the half year ending 30th June, 1881, which, with the half year's accounts to the 31st December last, presented at the ordinary general meeting on the 25th February last, show the financial result of the fourth year's working of the Company The revenue for the half year, after deducting out-payments, amounted to £93.581 14s. 8d. The working and other expenses for the same period, including interest on debentures, and income-tax, &c., amounted to £26.871 12s. 7d., leaving a balance of £66,710 2s. 1d. as the net profit for the half year, making, with £3,116 17s. 7d. brought forward from the previous half year, a total of £69,826 19s. 8d. Three quarterly interim dividends of 1½ per cent. each, amounting to £45,532 10s. have been declared and paid at the usual times during the financial year, and a final dividend of 5s. per share is now proposed, making, with the three interim dividends, 5 per cent. for the year, being a total distribution of £60,710. The appropriation of the above balance of £69,826 19s. 8d. on the revenue account is thus shown:—Interim dividend for quarter ending 31st March last, £15,177 10s.; final dividend now proposed, £15,177 10s.; carried to reserve fund, thereby increasing it to £235,000, £32,292 9s.; carried forward to next account, £7,179 10s. 8d. The cables are now, and have been since the last report, in good working order. In conjunction with the Anglo and French Companies it has been decided to reduce on and after the 1st August the tariff over the cables of the three companies to 1s. per word. Pursuant to the provisions of the articles of association two of the directors, viz.:—Lord Hawke and Sir Henry Keppel retire by rotation, and being eligible offer themselves for re-election. Mr. J. G. Griffiths and Mr. Joseph Sawyer, the auditors, retire pursuant to the articles of association, and offer themselves for re-election.

GLOBE TELEGRAPH AND TRUST COMPANY (LIMITED).

Report of the directors to be presented to the shareholders at the eighth ordinary general meeting, to be held at the Cannon-street Hotel, on the 29th July, 1881:—The balance-sheet and accounts for the year ending 18th July, 1881, with statement of the stocks and shares held by the Company at that date, are herewith submitted. The net revenue of the Company for the year, after deduction of expenses, amounts to £171,379 18s., which, with the balance of £841 12s. 8d. brought forward, makes a total of £172.221 10s. 8d. From this amount there has been distributed in interim dividends the sum of £122.066 8s., and the directors have written a further sum of £500 off the preliminary expenses account, leaving an available balance of £49,655 2s. 8d. The directors now recommend payment of a final dividend for the year of 3s. per share on the Preference Shares, and of 3s. per share on the Ordinary Shares (making, with the former distributions, a total dividend for the year of 6 per cent. upon the Preference and 4½ per cent. upon the Ordinary Shares), carrying forward a balance of £665 5s. 8d. The directors have issued 527 Preference Shares and 525 Ordinary Shares in exchange for 1,000 Eastern Telegraph Ordinary Shares; and an exchange has been made of 1,000 Telegraph Construction and Maintenance Shares for 3,000 Eastern Telegraph Ordinary Shares. Eleven shares of the German Norwegian Cable Company have been drawn and paid off at par. In conformity with the Articles of Association, Mr. William Ford and Sir Daniel Gooch, Bart., M.P., two of the directors, retire, but being eligible they offer themselves for re-election. The auditors, William Newmarch, Esq., F.R.S., and John George Griffiths, Esq., F.C.A. (Messrs. Deloitte, Dever, Griffiths, and Co.), also retire at the meeting. Mr. Griffiths offers himself for re-election, but Mr. Newmarch does not.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices July 20.		Business Done Week Ending July 20. Highest.		Lowest.	
Anglo-American	51¼,	¾	54		51¼	
Do. Preferred	82,	83	84¼		82¼	
Do. Deferred	24¼,	¼	27		24¼	
Brazil Submarine	10¼,	¼	10¾		10¼	
Cuba	9¾,	10¼	10¼		10	
Do. Preference	16¾,	17¼	—		—	
Direct Spanish	4¼,	5¼	5¼		4 15-16	
Do. Preference	13½,	14¼	—		—	
Direct United States Cable	10¾,	11	11¼		10¾	
Eastern Telegraph	10¾,	¼	10¾		10¾	
Do. 6 per Cent. Preference	12¼,	13¼	13¼		13	
Do. 5 per Cent. Debentures, 1899	106,	109	—		—	
Eastern Extension	11,	¼	11¼		11	
German Union	10,	11	11		11	
Globe Telegraph and Trust Company	6¼,	¼	6¾		6¼	
Do. Preference	12¼,	¼	12¾		12¼	
Great Northern	13¼,	¾	13¾		13¼	
Indo-European	23,	29	28¼		28¼	
Mediterranean Extension	2¾,	3¼	3		3	
Do. Preference	9,	9¼	9¼		9¼	
Reuter's	12,	13	12¾		12¼	
Submarine	285,	295	291¼		290¼	
West India and Panama	1¾,	2¼	2		2	
Do. 1st Preference	7,	¼	—		—	
Western Brazilian	8¼,	¼	8¾		8¼	
West. Union 7 per Cent. 1st Mortgage	125,	130	—		—	
Do. 6 per Cent. Sterling Bonds	106,	110	—		—	

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RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

4779. An Improved Electro-magnetic Apparatus for Table Services, Offices, and Warehouses, *F. Harmont.*—19*th November*, 1880. 4*d*.

This invention refers to a line of rails and carriages actuated solely by electricity or in conjunction with mechanical aid, such as a chain, &c., but where electricity plays the principal part. Hot or cold liquids for table service can be placed in a train of carriages which can be set in motion and stopped at will. The invention may be employed in breweries, warehouses, &c., where long distances have to be traversed.

4886. Improvements in Dynamo-electric Machines, *J. Hopkinson and A. Muirhead.*—24*th November*, 1880. 8*d*.

To reduce the sparks between the commutator and the collecting brushes, the latter are divided into parts, and that part which is latest in contact with any section of the commutator passes the current through a resistance, thus gradually checking the current as the contact is broken. Where the arrangement of the machine is such that the armature coils lie in planes parallel with the plane of revolution of the armature, the latter is thus constructed : The circumference of a pulley is snrrounded with a series of lavers of sheet iron insuluted from cach other. On one or both sides of this ring radial slots are cut to dmit the insulated wire. When a continuous

4886

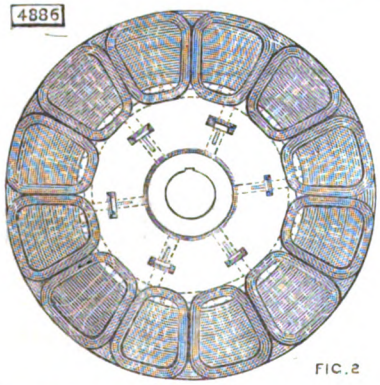


FIG. 2

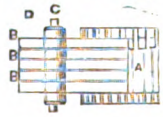


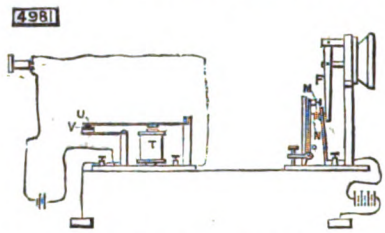
FIG. 1

current is required the coils are placed on both faces of the armature and arranged alternately. The field magnets are made similarly to the armature. Each coil is packed close against its neighbour, so that each is of approximately quadrilateral form. Fig. 1 shows the means for reducing sparks. A are segments of the commutator, B brushes, D a metal cylinder, the brush is attached to D, and the spindle C is in contact with another cylinder. The space between the cylinder is filled with a mixture of plumbago and lamp black, having a suitable resistance ; the ends of the space are closed with discs of ivory. The brush is so adjusted that it remains in contact with any segment of the commutator for a short space after the other brushes have left contact with that segment. Fig. 2 shows the armature as arranged for a continuous current.

4981. Telephonic Apparatus, *W. R. Lake.*—30*th November*, 1880.—(*A communication from C. A. Randall.*) 1*s*.

This invention relates to that class of telephone systems in which a battery current traverses the circuit of wires connecting the stations, and is qualified by tension changing and current breaking devices operated by the vibrations of a transmitter diaphragm. Its object is to utilise to a maximum degree the force of a line battery connected with a receiving apparatus, to cause an extended range of variation in the strength of the current of the line battery in correspondence with the variations of the transmitter diaphragm, and to effect an increased amplitude and force of vibration in the diaphragm of the receiver. The figure shows one of the arrangements of apparatus used by the inventor, the operation of which is as follows :—Upon speaking into the mouthpiece of the transmitting apparatus there is given to the diaphragm a to-and-fro movement, the effect of which is increased in force and amplitude at the circuit closer, viz., the plumbago button N and platinum stud M, by means of the lever F. These rapid movements alter-

4981



nately make and break the circuit over the main line, and the currents in turn pass over and through the receiving magnet T of the receiving apparatus, and cause a varying attraction of its armature corresponding to the amplitude of the vibrations of the diaphragm, which causes a varying contact between the carbon button V and platinum stud U in the local circuit, having the local battery and the telephonic receiver therein, so that the electrical impulses over the telephonic receiver correspond in number and in varying power to the vibrations of the diaphragm. Several modifications of the above apparatus are also described.

4988. Improvements in Electric Lamps, *K. W. Hedges.*—30*th November*, 1860. 6*d*.

The first portion of the specification refers to an improvement on former patents, No. 81, 8th January, 1879, and No. 925, 8th March, 1879, in the method of regulating the consumption of the carbons in an arc lamp. The inventor employs three carbons, A, B, and C, as shown in the figures ; two of these, B and C, constitute the positive electrode and lie in open troughs inclined to one another, the two carbons descending by gravity, and remain in contact notwithstanding their consumption. The third and negative carbon A also lies in an inclined trough and descends as it is consumed, butting against the stop shown, which permits its descent only according as the portion of the carbon against which it bears becomes wasted away. Contact is made by pieces of metal, D, hinged to the troughs as shown. In order to

4988

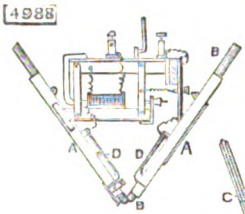


FIG. 1

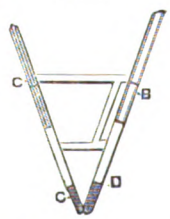


FIG. 2

adjust the distance between the negative carbon and the meeting point of the positive carbons the inventor mounts the trough containing A, so that it can move horizontally towards or away from those containing B and C, and connects it to the armature of an electro-magnet. When the lamp is inert, the end of the negative is brought into contact with the positive carbons by a weight or spring, and the lamp being put in circuit, the current passing through the carbons and through the coil of the electro-magnet, the armature is attracted, and a movement is given to the trough of the negative carbon, withdrawing it from the positive carbons and establishing an arc. The latter part of the specification refers to an incandescent lamp, so arranged that it may be used without glass.

5004. Measuring and Recording Electric Currents, *J. W. Swan.*—1*st December*, 1880. 6*d*.

This invention consists of an apparatus for measuring currents for electric lamps or other purposes. In the figures A is a cylinder revolved continuously by clockwork at a fixed rate. A number of pins are arranged on this cylinder according to the number of lights to be registered, as shown in Fig. 2, each pin acting on a set of levers. The action is as follows :—A lever, B, kept fixed against a stop, B^1, has attached to it another lever, C, so that it its own weight causes its extremity to engage with the teeth of the ratchet-wheel E. If A acts on B it will pro-

5004

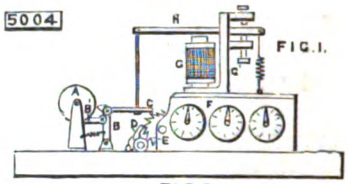


FIG. 1.

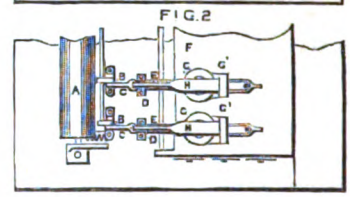


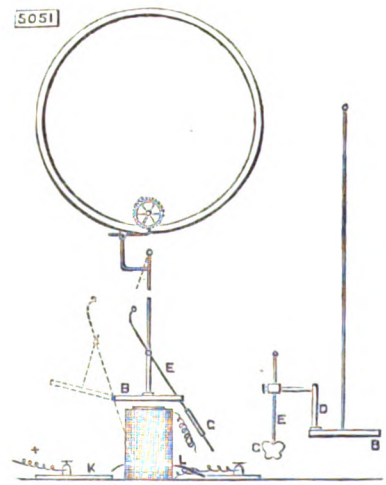
FIG. 2

pel E to the extent of one tooth, D serving to retain E in position until again propelled by C. E is connected with counting mechanism F. An electro-magnet, G, the coil of which is in circuit with one of the lamps, is placed under the arm H, mounted in an iron bracket, G^1, constituting one of the poles of the magnet. When H is attracted by G the rod, and with it the lever C are lowered, and E will be propelled one tooth for each revolution. E is mounted on an axis of the same length as A, and there are as many wheels, E, as pins on the cylinder A ; for each wheel there are the levers B and C, and arms and electro-magnets H and G.

5051. Improvements in Timepieces Worked by Electricity, *W. P. Thompson.*—4*th December*, 1880.—(*A communication from A. Lemoine.*) 6*d*.

This invention has for its object a system of electric timekeeping by means of an electro-magnet, which gives automatically to the pendulum a fresh impulsion each time that its oscillation fails to attain a certain amplitude of course. This is done by means of the light spindle with vane attached mounted on the pendulum, as shown, the vane being of mica or paper. As long as the range of oscillation of the pendulum does not descend below the normal limit, the spindle E passes the contact L without lowering it, by following the inclined path that the resistance of the

5051



air gives it, acting upon its vane. If, however, the oscillation diminishes, the speed of the pendulum diminishes, and the resistance opposed by the air to the movement of the vane G must equally lessen in such manner that the spindle approaches the vertical. It then presses the contact L, which bends upon K, so that the circuit being closed the current traverses the electro-magnet, which becomes active. As this effect is produced before the pendulum becomes vertical —see dotted lines—the armature B is attracted, and the pendulum regains its full range of oscillation under the influence of this impulsion ; E gliding over L, which again risis, the circuit is broken, and the pendulum oscillates as before.

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EASTERN ELECTRIC LIGHT AND POWER COMPANY

(LIMITED).

Capital £250,000, in 50,000 Shares of £5 each.

FIRST ISSUE £150,000, in 30,000 SHARES of £5 each, of which 7,600 are Vendor's Shares fully paid up. 22,400 Shares are now offered for Public Subscription. Payable—£1 per Share on Application, £2 per Share on Allotment, and the Balance by Calls as required.

DIRECTORS.

ERNEST NOEL, Esq., M.P., *Chairman.*
Gen. HENRY DYETT ABBOTT, C.B., Madras Staff Corps.
Gen. Sir ARTHUR THURLOW CUNYNGHAME, G.C.B.
ALEXANDER McARTHUR, Esq., M.P.
JAMES PENDER, Esq. (Director of the Oriental Telephone Company (Limited).
*LATIMER CLARK, Esq., M.I.C.E.
*Major CHARLES H. STRUTT.

* It is intended that these gentlemen shall join the Board, Major Strutt as Managing Director, after the allotment of shares.

BANKERS.

Messrs. Glyn, Mills, Currie, and Co., 67, Lombard-street, London.
Royal Bank of Scotland, Edinburgh, and its Branches.
Chartered Mercantile Bank of India, London, and China.

SOLICITORS.

Messrs. Bircham and Co., 26, Austin-friars, E.C.

CONSULTING ELECTRICIAN—Cromwell F. Varley, Esq., F.R.S., M.I.C.E.

BROKERS.

Messrs. Kenneth Anderson and Co., 1, Draper's-gardens, E.C.; Messrs. Joseph King and Sons, 26, Exchange-street East, Liverpool.

AUDITORS—Messrs. Deloitte, Dever, Griffiths, and Co., Chartered Accountants.

SECRETARY—Mr. T. Marshall Collet. OFFICES—Winchester House, Old Broad-street, London.

PROSPECTUS.

This Company has been formed for the purpose of introducing the Electric Light into India and other Eastern countries, where an extended field presents itself for its profitable application. The Company will undertake the supply of Dynamo and other electrical machinery, lamps, generators, and apparatus for the production of light, the transmission of power, the extraction of metals from ores, and similar operations.

The Company will not limit its operations to the production of light only, but will undertake the supply of Electric Power, which can be produced and transmitted by the same machinery as is employed for the production of the Electric light.

As the Electric light gives off but little heat compared with other sources of light, it is pre-eminently adapted for the climate of India, where the existing modes of lighting are open to many objections. A large number of lights can now be produced from a single machine, and the connecting wires can be extended for many miles, a circumstance which is essential for the effective lighting of the large cities and straggling cantonments of India.

In order to attain the objects for which this Company is established, the Directors have, under the agreements after referred to, contracted for the purchase of the Indian Patents of the Brush system of Electric lighting, with the right also of manufacturing in England for use in India the Brush machines, lamps, carbons, &c., and are thus enabled immediately to introduce into India the most perfect and efficient system of electric lighting at present known.

The Brush system has been adopted both in America and England on an extensive scale and with great success; and the aggregate of Electric illumination under this system is believed to be in excess of the total amount of Electric lighting under other systems.

In addition to the Brush Patents it has been deemed advisable to enter into an agreement to acquire the exclusive rights for India of the incandescent system of lighting known as the Lane Fox system, which is especially suitable for domestic purposes, and comprises lamps, regulators, exhaust pumps, &c. The Company will thus at once enter upon its operations with two of the most complete and efficient systems of Electric lighting hitherto employed.

The soft and beautiful light produced by the Lane Fox lamp is peculiarly adapted for the lighting of bungalows and the interiors of the palaces of the Indian Rajahs, while the Brush lamps are equally well suited for the illumination of their pleasure grounds; and both lamps are worked by the same machine.

Major Strutt has entered into the undermentioned agreements with the Anglo-American Brush Electric Light Corporation (Limited), and with Mr. Lane Fox, and with Messrs. Latimer Clark, Muirhead, and Co., and has contracted to pay the purchase moneys for the above patents and licenses, and transfer them to this Company, and to pay all costs of registration, advertising, and other preliminary expenses, including legal expenses and brokerage, up to the date of allotment for the sum of £32,000 in cash and £38,000 in fully paid up Shares, thus leaving out of the £112,000 now offered for public subscription an available working capital of £80,000, the balance of which will be called up only as it may be required.

The agreement with Messrs. Latimer Clark, Muirhead and Co., Electric Telegraph Engineers, of Westminster, provides for the manufacture by that firm at cost price, of the machinery and patented material required by the Company for working the above patents, the firm depending for their profit on a division of the net profit realised by the Company on the sale of such machines and apparatus. This arrangement saves time and capital, and obviates the necessity of the Company engaging a manufacturing staff, and undertaking the erection or purchase of extensive buildings, plant and machinery.

The profits of the Company will be derived from the sale of Dynamo machines, lamps, carbons, &c., the letting or leasing of lights and Electric power worked from central stations, contracts with municipalities, public bodies, firms, and private individuals, and from licenses which the Company may grant, and royalties to be paid thereunder.

The following agreements have been entered into:—

(1) An Agreement, dated 30th June, 1881, between CHARLES HENRY STRUTT of the one part and THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION LIMITED, of the other part, being an Agreement for the purchase of the Indian patents of the Corporation, together with some Dynamo machines, &c., available for the immediate commencement of this Company's operations, as also for the grant of a licence to manufacture in England the machines, &c., required for India.

(2) An Agreement, dated 1st July, 1881, between CHARLES HENRY STRUTT and ST. GEORGE LANE FOX, for the purchase of the patent rights of the latter in India relating to Electric lighting, together with a license to manufacture in England the machines, &c., required for India.

(3) An Agreement, dated 11th July, 1881, between CHARLES HENRY STRUTT and Messrs. LATIMER CLARK, MUIRHEAD, and Co.

(4) An Agreement, dated 15th July, 1881, between CHARLES HENRY STRUTT and THE EASTERN ELECTRIC LIGHT AND POWER COMPANY (LIMITED) for transfer of the above Agreements to the Company, and making provision for payment of preliminary expenses, as above stated.

The Agreements, and the Memorandum and Articles of Association of the Company, may be seen at the office of the Solicitors.

Where no Allotment is made the deposit will be returned, and if a smaller number of Shares be allotted than applied for, the surplus of the deposit will be applicable to the payment of the amount due on allotment. If any instalment is not duly paid the Allotment will be liable to cancellation, and payments previously made to forfeiture.

Applications for Shares must be made in the form accompanying the Prospectus and lodged, with the deposit of £1 per Share, with the Bankers.

20th July, 1881.

NO.....

FORM OF APPLICATION FOR SHARES.

TO THE DIRECTORS OF THE EASTERN ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

GENTLEMEN: Having paid to your Bankers the sum of £ , being a deposit of £1 per Share, I request you to allot me Shares of £5 each in the Company, and I agree to accept such Shares, or any less number that may be allotted to me, upon the terms of the Prospectus, dated 20th July, 1881, and the regulations of the Company, and I authorise you to register me as the holder of the Shares allotted to me.

Signature in full.....
Address.....
Description.....
Date July, 1881.

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THE GLOBE TELEGRAPH and TRUST COMPANY (Limited).—NOTICE is HEREBY GIVEN that the EIGHTH ORDINARY GENERAL MEETING of the Globe Telegraph and Trust Company (Limited), will be held on Friday, the 29th July, 1881, at 12 noon, at the CITY TERMINUS HOTEL, Cannon-street, E.C., London, when the report and accounts of the Directors will be presented, final DIVIDENDS for the year on the preference and ordinary shares will be declared, and the ordinary business of the Company transacted.

Notice is also given that the REGISTERS of TRANSFERS will be CLOSED from the 21st to the 29th July, both days inclusive.

By order, WILLIAM PAYTON, Secretary.

No. 66, Old Broad-street, London, 20th July, 1881.

ELECTRIC LIGHTING.

THE

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION

(LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates, and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation is also prepared to receive applications for licences, or for concessions for defined districts, and to enter into negotiations with responsible parties for the sale of licences for the British Colonies. The superiority of the Brush system in economy and simplicity being thoroughly established, its rapid development is now assured.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians, 86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.

Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.

THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.

Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.

All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.

Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.

Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.

Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.

Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.

Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

JOHNSON'S TRANSMITTER

(PATENT).

LOUD AND CLEAR. NO JARRING.
PERMANENT ADJUSTMENT.
NO OXIDATION. ONE LOCAL CELL.

TASKER, SONS & CO.,
ELECTRIC AND TELEPHONIC ENGINEERS,
SHEFFIELD.

VULCANITE.

HARBURG INDIA-RUBBER COMB COMPANY.
LONDON WAREHOUSE: F. WINTER.
138, LONDON WALL, WOOD ST., E.C.

EBONITE.

DUNCAN WALLET & CO.,

BONDED STORE AND PROVISION MERCHANTS,

15, BILLITER STREET, LONDON.

Special Arrangements made for Supply of Goods to Telegraph Stations.

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SLIP

THE RANELAGH CLUB.—On Saturday, the 23rd inst., the last polo match by the electric light was played at this club.

ELECTRIC LIGHT AT ANTWERP.—The electric light is being used on the works of the extension of the dry docks at Antwerp.

SCOTLAND.—Telegraphic communication with the Island of Islay, which has been interrupted for some months past, is now restored.

INDIA.—Telegraphic communication with India is very uncertain just now, and many mercantile houses are without their advices.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this Company for the week ended 22nd inst. amounted to £2,770.

UNITED STATES TELEGRAPHS.—The American scientific and telegraphic journals continue to advocate the acquisition of the telegraphs by the State.

OVERTIME.—The "Western Union," says the *Operator*, has started a system in some of its offices of making its men work extra hours without extra payment.

ACCIDENT BY LIGHTNING.—On Wednesday last during a thunderstorm a chapel at Foleshill, near Coventry, was struck by lightning, and the roof was considerably damaged.

ELECTRIC RAILWAY IN AUSTRIA.—According to the *Neue Freie Presse* the South Austria Railway Company are about to establish an electric railway from the Moedling station to Brühl.

THE NEW ATLANTIC CABLE.—The telegraph steamship "Faraday" on Thursday, July 21, landed at Whitesand Bay, near Land's End, the shore end of another new Atlantic cable.

TELEGRAPH WIRES IN SEWERS.—A committee appointed to report upon the scheme for running electric wires through the sewers of Philadelphia City have decided adversely to the proposal.

SOUTH AMERICA.—The cables between Montevideo and Rio Grand do Sul, and between Bahia and Rio de Janeiro are again interrupted. Messages usually sent by those routes must now be sent over the Brazilian Government land lines.

A NEW TELEPHONE COMPANY.—The People's Telephone and Telegraph Company has filed articles of incorporation at Albany, New York, this month. The capital stock is to be 1,000,000 dols., with power to increase to 10,000,000 dols.

BROOKE'S SYSTEM OF INSULATION.—We understand that the work of extension of this system has been completed between Waterloo and Clapham, that the tests are satisfactory, and that in a few days it is to be tested for telephonic work.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this Company for the week ending July 22, 1881, amounted to £1,876, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

PRICES.—The prices as quoted are:—For gutta percha, per lb., genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber, per lb., fine Para, 3s. 6½d.; negrohead, 2s. 2½d.; central American, 1s. 9d. to 2s. 3½d.; Assam and Pegu, 1s. 3d. to 2s.; other East Indian, 1s. 4d. to 2s.; Madagascar and Mozambique, 1s. 6d. to 2s. 3d.

PERSONAL.—The editorial staff of *The Electrician*, at the invitation of the "Companionship" of *The Observer*, joined them in their annual excursion and dinner, which took place at a picturesque spot on the Thames, near Maidenhead, on Wednesday last. The weather was fine, and the company numbering between fifty and sixty, had a very enjoyable outing.

S.S. "CHILTERN."—This vessel, lying off the Telegraph Construction Works, Greenwich, has now completed taking in cable, and will proceed to Aden, thence to Bombay, sailing on the 30th instant. She has been fitted with Sharp and Co.'s Crown Ejector Ventilators, which pump up and eject the vitiated air. This will be a boon in the hot climate to which she is going.

CANADIAN TELEGRAPHS.—An Ottawa telegram states that the Canadian, European, American, and Asiatic Company, to which a charter was granted in the last Dominion Parliament, has completed its organisation. The Canadian end of this cable will land on Sable Island. Telegraphic communication will also be established with the West Indies.—*Liverpool Journal of Commerce.*

THE FAURE BATTERY AND TRAMCARS.—Another trial has been made with this battery as a motor for tramcars. *La Lumière Electrique* says that an experiment was made the other day on the lines of the Compagnie des Tramways de Roubaix at Tourcoing. The cells were stowed under the benches, and contained motive power sufficient to run the car for four or five hours.

FAURE'S ACCUMULATORS.—The Force et Lumière Company has definitively given up the idea of conveying the charged "accumulators" to and fro between the points where the energy is stored up and where it is expended. The apparatus, as was shrewdly predicted in several quarters, will be maintained *in situ* on the premises of subscribers, and charged by means of conducting wires from a central station.

ELECTRIC LIGHT AT IPSWICH.—Messrs. Packard's extensive premises are now lighted by the Burgin system, introduced by the Electric Lighting Supply Company, London, under the superintendence of Mr. Kellingworth Hedges, C.E. Two of the lamps are so placed as to give light to the holds of vessels discharging alongside the quay, and to enable the men to attend to the crane and hoist without the aid of gas or oil.

TELEPHONE WIRES IN BELGIUM.—A good deal has been heard lately in France, the United States, and amongst ourselves of overhead telephone wires, and in the two former countries they have been in most towns ordered to be placed underground. In Belgium, however, they are still carried overhead, and as the telephone is largely used in Brussels, Antwerp, and the larger towns, these wires present a most dangerous appearance.

THE ELECTRO-CHEMICAL EQUIVALENT.—According to M. Mascart, the Weber current decomposes in one second ·09373 milligrams of water. The figure generally accepted at the present time is ·092 m.g.; but the first determination made by Weber (·0976 m.g.) was almost identical with the former number. Adopting the new value, the Weber current will liberate or dissolve at each electrode ·010415 of the equivalent of a body expressed in milligrams, or 96·01 Webers will re-act upon a milligram-equivalent in each cell.

MONOPOLISTS.—According to the *New York Hour*, Messrs. Jay Gould and Robert Garrett are supposed to be contemplating a consolidation between the Baltimore and Ohio and South Western systems, which would make those two men masters of one-third of the railway properties of the whole country. The entire telegraph system of the United State

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is now monopolised by one man, and the same great speculator has laid his plans for capturing all the submarine cables of the world, and it is not impossible that he may succeed.

THE SUBTERRANEAN TELEGRAPH IN GERMANY.—The laying down of the cable between Berlin and Stettin, which was effected the other day, completes the subterranean telegraph system in the German Empire. These cables now cover 3,420 miles, nearly all of them having seven wires, and they have cost £1,510,548. They are laid beneath all the principal rivers, and establish direct telegraphic communication between 221 different cities and towns of the German Empire. The first cable was laid just four years and eight months ago.

ILLUMINATING NIAGARA FALLS.—Additional machinery is now used in illuminating Niagara Falls by the electric light. On the evening of July 6 the first exhibition of the new improvement was given, with a strangely grand effect. The light now is strong enough to reach the Horseshoe Falls and penetrate the huge clouds of spray. The American Falls are reached at every point and form a beautiful view. New reflectors have been placed in such a position as to throw strong rays of light on the rapids, just above the Falls, which resemble a huge sheet of quicksilver, the whole forming a magnificent illumination.

RECORDING APPARATUS FOR MIRROR SIGNALS.—M. Paul Samuel recently laid before the Academy of Brussels an apparatus for this purpose, which has since been favourably reported upon by M. Honrean. It consists of two selenium cells so placed that the spot of light from the mirror falls upon either of them, according as the movement is to right or to left. The diminution in the resistance of the selenium, produced by the light falling upon it, is made to augment a current in the circuit of an electro-magnet; and, the armature being attracted, the signal is registered either by mechanical or by electro-chemical means. The elementary signal is, on one side, a *dot*, and, on the other side, an upright *dash*.

A TELEPHONIC DIRECTORY.—The United Telephone Company have issued the second edition of their subscribers' list, which is brought up to the 20th of July. The list is classified under the heads of the professions and trades to which the subscribers belong. In a preface to the list it is stated that the company have now in London upwards of 1,000 subscribers, and that the "calls" average 6,000 a day. As we stated in a recent note, the company have arranged with the Post Office to connect three of their exchanges with the Postal Telegraph Department at St. Martin's-le-Grand, so that messages can be handed to non-subscribers having their place of business within a short radius of the Post Office at a charge of 3d. per twenty words, or they will be forwarded anywhere in the United Kingdom at the usual rates for telegrams.

OVERHEAD TELEGRAPH WIRES.—The answer of the Attorney-General to Mr. W. H. Smith's question with reference to accidents from the fall of telegraph wires may relieve the anxiety of "public bodies having control over the streets;" but it gives considerably less security to the bodies of the public by whom the streets are used. In effect, Sir Henry James's reply amounts to this—that nobody is legally responsible for the accidents in question, but that it will be "all right." Before the transfer of the telegraphs to the State, the telegraph companies were statutorily liable "for all damage and costs arising from the default of their servants—public bodies having control over the streets being held harmless." But when the telegraphs were taken over by the Post Office "there were no express words rendering the Crown liable to be placed in the same position as the companies; and legally and technically that could not be so, for the Crown could not be subjected to an action for wrong." —*St. James's Gazette.*

THE METROPOLITAN TELEGRAPH CLERKS.—An urgent appeal from the Metropolitan District Telegraph Clerks to the members of the House of Commons has been issued, setting forth reasons for considering as unsatisfactory the scheme lately promulgated. The reasons are, that whereas clerks, before making application for admission into the service, were told they had a prospect of rising to £160 per annum, under the new scheme there was no prospect of more than £140 per annum; that large numbers of the juniors in the central office are far ahead of the memorialists in respect of salary, and under the new arrangement these numbers will continue to increase every year; that after obtaining an additional £10 per annum, many will again have to wait for promotion an indefinite number of years; if all the barriers to promotion were removed, it would still be necessary to serve twenty years before receiving £140 per annum; whilst, should the senior class be extended to the districts, £190 per annum would be the most a clerk could get were he to serve his full forty years.

THE TELEGRAPH CLERKS AND SCIENTIFIC EDUCATION.—The *Manchester Guardian* observes that:—"Whilst the telegraph clerks of the country are seeking higher remuneration for their services, it is satisfactory to note that, in this district, the clerks, female as well as male, are exerting themselves to acquire a competent knowledge of the scientific theories relating to their occupation, and so, to this extent, deserving a higher place. Last autumn a class was formed in electricity and magnetism, in connection with the Science and Art Department, consisting chiefly of *employés* at the central office, York-street. Following the usual course of instruction, which was conducted at the Manchester Mechanics' Institution, 19 members of the class attended the examination, the results of which are just announced. Seventeen clerks have gained the Department's certificate, seven of the number being ranked in the first class. The above course is complementary to the instruction in practical telegraphy, one of the technical subjects of the City and Guilds of London Institute, scientific as well as technical knowledge being required for the Institute's full certificate.

ELECTRICAL TRAMWAYS.—The Berlin and Charlottenburg Tramway Omnibus Company are going to avail themselves, with regard to one of their routes, of Siemens and Halske's adaptation of electricity to locomotive purposes. The working machine, which will be fitted underneath the floor of the tramcar, will be supplied with the current in a somewhat different manner from that employed for the electric railways already in existence. Two lines of cable, insulated and supported similarly to ordinary telegraph wires, on posts sixteen feet high, are to be erected alongside of the tramway. Upon this pair of cables is to be fitted a small four-wheel contact carriage, as it is called, which will be connected with the working machine beneath the tramcar by means of two short cables. The current will then proceed from a stationary dynamo-electric machine at the terminus, along one of the lines of cable, and thence through the wheels of the contact carriage into one of the connecting cables, by which it will finally reach the working machine. The second cable will serve for the return current. As the tramcar moves, the contact carriage connected with it will, of course, be drawn along the pair of cables. (For illustration of this system see *Electrician* of the 16th inst.)

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INDIAN TELEGRAPH TARIFF.—The *Pioneer* commenting on the Government proposal that from July 1 Indian telegrams of more than six words will be charged for at the rate of one rupee for the first six words, and two annas for each word in excess, says:—"This arrangement is a half-hearted measure, calculated neither to afford satisfaction to the public nor profit to the telegraph department. Had the number of words in the rupee message been raised to eight, with a two-anna rate for each word in excess, there would have been a semblance of liberality in the change, while it would have been possible to arrive at the cost of a message of any length by a single calculation. As it is, if we wish to send a telegram of twenty words, we must first deduct six words as costing one rupee, then multiply the remaining fourteen words by two for the number of annas, then divide by sixteen to obtain rupees, and finally add the two results together. A more complicated arrangement could scarcely have been inflicted on the public; and yet if there is a class for whom the procedure in respect of telegrams should be simplified, it is the natives of India. The obvious inconvenience of the new system of counting will speedily necessitate a further change, which, it is to be hoped, will be conceived with somewhat more judgment."

SOURCE OF ELECTRIC ENERGY.—In the *Journal of Science* for July Mr. Charles Morris writes upon this subject. He says:—"If instead of heat being conducted from one substance to another, two substances be rubbed together, similar results appear. If they are homogeneous, it partly or entirely becomes electricity; and if the energy emitted be that produced by chemical action between diverse substances a like result appears, electricity is produced. In short, in every case in which two homogeneous surfaces receive excess motive energy, this energy flows from one to the other as heat. In every case where two heterogeneous surfaces receive excess motive energy, this energy, partly or completely, flows from one to the other as electricity. But all this electricity is eventually converted into heat or into some condition in correlation with heat. Its existence as electricity is usually but temporary, and the necessary condition for the temporary conversion of heat energy, or of chemical or mechanical energy, into electricity, appears to be diversity of tension in the molecules of contiguous surfaces. The same diversity exists between the molecules of heated solids and those of the gas or ether in contact with them. There is thus an analogy of condition between the production of light and of electricity. Whether this is significant of a resemblance in character remains to be proved." . . . . Later on he says:—"Electricity and light hold to each other the following relations:—Transparents to light are, as a rule, opaque to electricity. Transparents to electricity are opaque to light. . . . To gain a full conception of radiant energy, the phenomena of etherial radiance and electricity must be considered in common, and dealt with as the various phases of one general mode of motion."

THE ELECTRIC LIGHT IN INDIA.—The following description of the lighting of a cotton mill owned by Messrs. Mackinnon, Mackenzie, and Co., at Garden Reach, Calcutta, appeared in the *Indian Daily News*:—"The lights were lit at dusk, and continued burning for some time with marked steadiness and great success. The light in the rooms is ample for all the different minute manipulations of the blowing, cording, spinning, winding, reeling, packing, baling, and mixing rooms. The light in these latter rooms was specially admirable, as the reflection from the white cotton and yarn aided the light, and the least specks in the cotton could be detected. The arrangement of the light is specially interesting in this mill, and shows the practical experience of the proprietors and the ingenuity of the electricians. A 20-light machine is driven from the workshop engine, and a similar 20-light machine is driven from the main engine shaftings; some of the lights of *each* machine are placed in *each* room throughout the three storeys of the mill. By this means, if there is an accident to one of the machines or engines, there will still be sufficient light in the rooms for ordinary purposes; and the lights of one machine would serve for repairing the accident to the other, or either engine, during the night. The machines revolve at a speed of 1,200 revolutions to the minute, and the power required for the thirty-six lights is only about twenty-eight indicated horse-power. Each light represents the power of about forty gas jets, or 500 standard candles; the thirty-six lights in the mill represent, therefore, the power of about 18,000 candles, and the reflection from the white walls and cotton in manufacture prevents any of the light being lost. Considerable reductions have taken place in the prices of the candles, and they are half the price they were formerly; each light of about 500 candle power costs now, inclusive of fuel and attendance, less than two annas per hour. Now, at any rate, the electric light is no expensive luxury. The light is extremely mild and pleasant in the opaline globes. The globes are hermetically closed, and consequently danger from fires is reduced to a minimum, and the health and comfort of the workmen considerably profited."

IRIDIUM.—The following is a brief abstract of the patent granted to John Holland, of Cincinnati, Ohio, for fusing and moulding iridium. The patent is dated 10th May, 1881. "Iridium is rarely found pure, and only in dust and very small grains or scales. By reason of its non-fusibility by the ordinary processes it is practically useless, except for pointing gold pens, and as found there is but a small proportion of it large enough to be used with advantage for even this purpose. I have also used it in its natural state, and, as usually found, alloyed with osmium (iridosmium, which is much softer than pure iridium), for pointing my fountain pens, and have experienced much difficulty in obtaining grains or scales large enough for this purpose, and many of these were imperfect, having cracks or fissures in them that rendered them worthless for drilled fountain pen points. The pieces as obtained are also of irregular shape. A large portion of the metal must, therefore, be wasted, as the dust which results from grinding the grains to the proper shape was of little use. To fuse the dust of the metal as found in its natural state I proceed as follows:—The metal is put into a sand crucible and subjected to a high heat in an ordinary furnace. When it has attained a high temperature I add to the metal about one-fourth its weight of phosphorus. After the addition of the phosphorus the metal quickly fuses, when it may be poured into moulds of any shape or size. I find it best to have the moulds highly heated, as the metal chills and sets quickly. So soon as the metal is set I place it in a crucible with chalk or lime, return it into the furnace, and again subject it to a high heat. This eliminates the phosphorus, leaving the metal pure, hard, and non-fusible, as in its natural state. The metal is made much tougher by eliminating the phosphorus but it may be used for many purposes without so doing."—Mr. Holland writes as follows to the *Scientific American*:—"I take the liberty of presenting you with a specimen of the metal. The ore was Russian, which I find softer and less refractory than the California iridium; still I have melted all kinds of the ore, and made it run about as free as silver.

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I use a common draught furnace and a Hessian crucible. The quantity of the ore is quite large in Russia and in California. I hope soon to see it extensively used in the mechanical arts. It is very hard, will not oxidize, and is not magnetic. I have kept one piece of it, 8 dwts. in weight, on the negative pole of a dynamo-electric machine for five weeks. There was no loss in weight, and had it not met with an accident by falling while hot it seemed likely to last for a long time. The light produced was white in colour, and as the iridium is a good conductor of electricity the light was fully one-third stronger than the lamp made with both poles of carbon."

Sir Wm. Thomson on Electric Lighting.—The following letter, addressed to a member of the Glasgow Town Council, has been published :—" Glasgow, 28th June, 1881.—Dear Sir,—I think you are quite justified, by the course of events in respect of electric lighting within the last three years, in the judgment you form as to the future for it and for gas, so far as lighting in cities is concerned. I feel very sure that so far as economy of physical resources, of coal, &c., and satisfactoriness of the result in respect to health and comfort are concerned, electric lighting ought to supersede lighting by gas in towns in the course of a very few years. The large interests involved in gas works must be and ought properly to be a very serious question on the other side. It seems to me that you are quite right in taking time by the forelock to reduce the capital account of the Corporation gas. Could you not do more, and let the same interests merge gradually into electric lighting? If you could get an Act to allow the Corporation to adopt electric light as an extension of the lighting by gas for which you have powers, I believe that the inevitable change from lighting by gas to lighting by electricity would take place beneficially instead of disastrously in respect to the Corporation's interests in gas works. If you could get an Act permitting the gas works to fill their pipes with copper and insulating material, they would then be ready to do electric lighting with vastly better economy and more profits than any other parties. — Believe me, &c. (Signed), William Thomson." A subsequent letter on the same subject to the *Glasgow Herald*, dated the 21st July, is as follows :—" Sir, —It will be curious in a few years hence to read the correspondence between Sir William Thomson and Mr. William Ure in regard to electric lighting, and to recall the gentle but prophetic language of the Professor of Natural Philosophy in drawing attention to the effect that 'electric lighting ought to supersede lighting by gas in towns in the course of a very few years.' After a crucial investigation into the merits of electricity for lighting purposes, I have come to the conclusion that it possesses inherent advantages which cannot be ignored, and I venture to corroborate the opinion of my distinguished friend in believing that the 'change from lighting by gas to lighting by electricity is inevitable,' and that as surely as gas supplanted oil and tallow, electricity will supersede gas. The Cunard steamship " Servia" is being fitted with 98 lamps for electric lighting on the most effective principle, having alternate current machines which possess self-regulating qualities, so that the light of lamp after lamp may be turned on or off without affecting the brightness of the rest; and surely if at sea, subject to the motions of a ship, the electric light can be used with great benefit, combining safety, brilliancy, and economy, it can be adopted for use in our cities. I am glad to observe that Mr. Ure considers the ' suggestion well worthy of consideration,' and I trust that Glasgow will be foremost in recognising the expediency of quickly grasping a scientific achievement which sooner or later must command the attention of the entire community by its value and utility.—I am, &c., John Burns."

The Royal Observatory.—At the annual meeting of the Board of Visitors of the Royal Observatory, Greenwich, held on Saturday, the 4th of June, Sir George B. Airy, the Astronomer Royal, presented his report, the substance of which we reproduce so far as it concerns us. The followlowing are the principal results for magnetic elements in the year 1880 :—Approximate mean westerly declination, 18° 32′; mean horizontal force, 3·912 (in English units), 1·804 (in metric units); mean dip, 67° 34′ 55″ (by 9-inch needles), 67° 35′ 53″ (by 6-inch needles), 67° 36′ 3″ (by 3-inch needles). The report states that :—" In respect of diurnal inequalities of magnetic horizontal force and its direction, though all measures are ready, the curves are not yet actually formed. In the last report I adverted to the usual character of these curves. Assuming it to be certain that they originate from the sun's power, not immediately, but mediately through his action on the earth, it appears to me (as I suggested long ago) that they are the effects of the attraction of the red end or north end of the needle by the heated portions of our globe, especially by the heated sea, whose effect appears to predominate greatly over that of the land. I do not say that everything is thus made perfectly clear, but I think that the leading phenomena may be thus explained, and this is almost necessarily the way of beginning a science. The discussion of the electrometer results for the year 1879 shows that the potential of the atmosphere is usually positive; that it is least in summer and greatest in winter, and especially in the colder weather of winter. There is also a definite diurnal inequality, having double maxima and minima, the maxima, on the average of the year, occurring at about 8h. a.m. and p.m. and the minima at about 3h. a.m. and p.m. In character the diurnal curve has a resemblance to the barometic curve, but the points of maxima and minima precede those of the barometric curve by about two hours. On days of magnetic disturbance, when aurora is visible, nothing unusual is remarked in the electrometer indications. Excepting thunderstorms, the greatest disturbances are experienced in showery weather, and are probably local disturbances only. Last autumn a telegraphic determination of the longitude of Leiden was made with great care by M. M. Bakhuyzen. The interchange of signals between Greenwich and Leiden occupied nearly four months. I may here remark that the American extension of longitude carried out under Commander Green, U.S.N., to which reference was made in the last report, will be most useful for the transit of Venus in 1882. Cannot a British officer be found to complete the operations for Australia and New Zealand? I lament that this has not been done. Mr. Gill has undertaken the necessary work for the Cape." Speaking of his view of the general objects of the Observatory, Sir G. B. Airy said with reference to the subject of navigation :—" I may remark that magnetism, in its ordinary and nautical form, is indisputably a proper subject for the Observatory. But within the present century there have arisen :—The accurate examination of magnetic irregularities, the partial reduction of daily irregularities to practical laws (still wanting theoretical explanation), and the establishment of the simultaneous co-existence of occasional disturbances covering the whole surface of the earth. Connected with these is the observation of magnetic currents through the terrestrial soil, registered at Greenwich for many years past, and now attracting attention on the Continent. Perhaps no branch of physics bears the same prospective importance as these. Yet I conceive that their continued study in this Observatory requires special authorisation."

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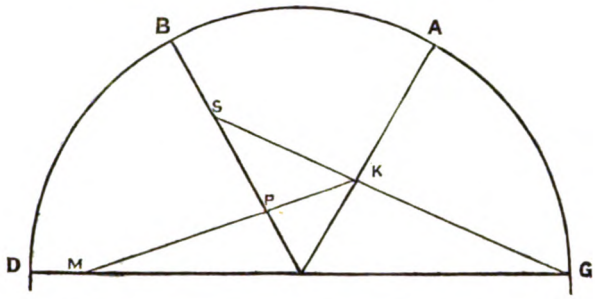
CORRESPONDENCE.

ON A GRAPHIC METHOD OF FINDING THE JOINT RESISTANCE OF TWO OR MORE WIRES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Perhaps the following may interest some of your readers:—With C as centre, describe the semicircle DBAG of as large a radius as is convenient. Divide this into three equal parts by the radii CA and CB. If the lines CG, CA, CB, and CD be carefully graduated into as small divisions as possible, a straight-edge joining any two resistances on either of the pair of radii which are separated by two sectors will cut the intermediate radius at the joint resistance required. This last can be used with a third resistance on the



radius, which is two thirds of a semicircle from it, to obtain in like manner the joint resistance of the three wires. Thus CK is the joint R of CG and CS, and CP is that of CG, CS, and CM, and so on for any number of wires.

Again, let the radius CG = CA represent the galvanometer's resistance, and CS the shunt's, then AK will represent the compensating resistance to be used with this particular shunt; and a line drawn through the unit division on CA and parallel to GS will cut CG at the multiplying power n of that shunt.

I omit the proof of the above, as it is rather long, but will furnish it if desired.—Yours, &c., ARTHUR WRIGHT.

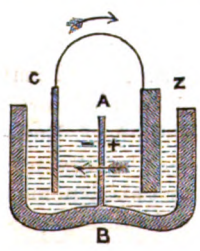
S. Hampstead, July 22, 1881.

THEORY OF VOLTAIC ACTION.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In the concluding part of Professor Helmholtz's very interesting lecture in your issue for July 16, p. 141, occur the words:—"I have not found in all the papers which have been written for the defence of the chemical theory a clear explanation why zinc opposed to copper in liquids, where zinc really is oxydised and dissolved becomes negative; and why in air and other gases it becomes positive if the same cause, namely oxidation, is at work."

I trust the following explanation will be sufficiently ex-



plicit and sufficiently reasonable to meet with intellectual acceptation.

In a cell of copper zinc and water, the current flows, of course, from zinc to copper in the liquid. Now, if a non-conducting diaphragm, $a\,b$, be placed across the liquid, will there be a charge of positive electricity on the side of it next the zinc and of negative on that next the copper? Experiment says yes. If $a\,b$ be a thin air space, and the liquid on the side of it next the zinc be a mere film of moisture, will there still be a positive charge on the outer surface of this film? Experiment again answers in the affirmative. And if, after disconnecting the zinc from the copper, we remove it, we find it charged with this positive electricity, which was at first "bound" by the negative charge on the moisture film on the copper. This seems to me the rational explanation of Volta's fundamental experiment.—Yours, &c.,

Belfast, July 22, 1881. J. BROWN.

THE DIVISION OF THE ELECTRIC CURRENT.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: A few days ago I was requested to call at 49, Farringdon-road to inspect an "invention" of Mr. J. Banting Rogers for dividing the electric current. On entering the workshop we were shown a couple of Bunsen cells with wires leading to a small wooden box. From this about six wires emerged, each pair of which was again led to a similar case, also furnished with wires, so that the current was divided into thirty-six branches. On six of these, small electric bells were placed, the whole being arranged in the common parallel combination. Mr. Rogers, however, chose to assume that the current was divided thirty-six times, and that if bells had been placed on all the other branches they would also have rung, with the same battery power. On my replying in the affirmative to his query as to whether I had seen such an arrangement before, he immediately shouted out to the workman to desist from fixing the battery, as here was "some one who understands all about it," and nothing further was done until the arrival of a "Mr. Arthur Shippy, accountant, of 13 and 14, King-street, Cheapside." This gentleman was represented as the promoter of a company which was being formed to carry out this wonderful "invention." On his appearance the apparatus was set in action, bells were rung, water contained in small tubes was decomposed, and a slight deposit of copper was formed by electro-deposition, all of which experiments seemed to impress the spectators immensely.

The cover was removed from one of the mysterious boxes, so that we could inspect the contents. These were of the most ineffective description. A small tin globe was attached to each of the main wires, while around were placed a number of equi-distant loops, to which the branch wires were connected, the inventor being possessed of the astounding belief that this arrangement would not only distribute the current equally, irrespectively of the varying external resistance of the different circuits, but would actually store up the electricity, and act as an accumulator! After all this, one was not surprised to hear the deduction that if all these effects were obtained with a Bunsen battery, still more striking ones were to be obtained from a dynamo machine. However, I will not occupy your valuable space with a description of the further farces that were solemnly gone through.

Now, what I want to call your attention to is this. Mr. Rogers may possibly be so profoundly ignorant of even the rudiments of electricity as not to understand the absurdity of his arrangements, and Mr. Shippy may possibly have an equal amount of faith in the former gentleman's statements, but it would be lamentable if these conditions should permit these persons to collect a considerable sum of money from a credulous public for the furtherance of an absolutely visionary scheme.

I see by the prospectus issued that some of your contemporaries, who ought to have known better, have actually been induced to insert favourable notices of this invention, and that, therefore, nothing except a thorough exposure of the whole affair from some influential journal can put a stop to a credulous public investing their money in this concern.

July 20, 1881. F. C.

[It seems clear, from our correspondent's letter, that the invention he describes is illusory, and that this is one of the cases in which probably everyone concerned requires to be protected from the results of a want of knowledge in relation to the subject of their endeavours. At the same time, if

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anything can be urged in favour of the arrangement, we are willing, for the sake of equity, to allow expression to a contrary view.—Ed. *E.*]

WHAT IS ELECTRICITY?

TO THE EDITOR OF THE ELECTRICIAN.

Sir: As an advocate of the material nature of electricity I desire to offer a few remarks on Mr. Johnstone's contention.

His style of assumption and positivity may well justify the silence of such able men as Mr. Fleeming Jenkin and Mr. J. E. Gordon. It is a common axiom with electricians of eminence and ability that we know very little of the true value of electricity; and viewed from their point of view, and fairly appreciating their great responsibility as teachers, having to cover the whole ground in their exposition of the facts and laws of electrical phenomena, I cannot but think that the statements criticised with such off-hand vehemence by Mr. Johnstone are models of humble, cautious, and very skilful exposition.

There is manifested in a variety of ways a mysterious duality of effects, and I have long been impressed with the conviction that the opposite + and — currents are *one thing* viewed under different aspects.

Optical physicists are, perhaps, more dogmatic in representing the essential differences between the ordinary and the extraordinary rays of double refraction, where, I believe, a similar absolute unity also subsists.

But the language of Mr. Fleeming Jenkin is so carefully studied, and evinces such a large grasp of complex phenomena, that it will probably be eclectically esteemed by another generation, when the material basis of electrical phenomena may stand more clearly revealed.

It may seem strange, after this introduction, if I partially take sides with Mr. Johnstone, but I do so with the conviction that we may find justification in the teaching of Mr. Fleeming Jenkin, and that, duly appreciating our new point of view, he would also fully endorse our results:—

Is a Holtz machine or a battery an apparatus for separating the two electricities, driving the + in one direction, and — in the opposite; or is it, as Mr. Johnstone contends, a proved fact that a similar direction of current subsists on both sides?

The simple truth unquestionably lies with the latter, and the former is only true in some special if not deceptive aspects:—

Let us imagine three similar sets of apparatus.

1st. A steam engine or other motor, raising water from a river for the irrigation of higher levels.

2nd. A Holtz machine with one side connected to earth, and the other available for work of various kinds; and

3rd. A voltaic battery under similar conditions.

Now a little consideration will show that the main principle of action is the same in all three cases.

Tested for *direction and quantity*, the pipe leading from the river to the apparatus, is strictly identical with that leading from the apparatus to the fields; and precisely thus it is with the Holtz machine, or any other form of voltaic battery. Tested for *direction and quantity*, the wire leading from earth to apparatus is strictly identical with that leading from the apparatus to the varied applications of work, all of which end in a final return to earth, as in the case of water irrigation.

To prove this, we need no speciality of gas flame, which, in all probability, Mr. Johnstone does not clearly understand. An *à priori* consideration of the absurdity involved in the opposite view would almost be sufficient, seeing that in either case there is no internal reservoir for an endless supply of outgoing material results. But the fact admits of the most easy proof, as tested by an electrometer, a galvanometer, a voltameter, or by the action of a gas flame, when either is fairly applied.

How then can it be, if this be so plain, that the opposite view has been so widely entertained?

The answer is an easy one, and is another illustration of the axioms referred to, viz., the mysterious duality of effects and the little that is known of the material basis.

Given a battery of low tension (voltaic) or of high tension (Holtz machine) and we proceed to test from one side, with a galvanometer or either of the above appliances, and find, say a + current; we then employ the same testing conditions, on the other side (the tester and apparatus being really turned round), and we invariably find an opposite character of current; and hence the prevalent conviction, that if a positive current issue from one pole of a battery, it is certain that an opposite or — current must flow from the other pole. However feasible this may appear, and however widely spread the acceptation, still any fair examination of the hydraulic case is quite sufficient to open one's eyes to the absurdity involved; because the identically same current, when thus tested, would appear to have a diametrically opposite character of direction.

All these considerations imply working from and to earth as an infinite reservoir; but the same principles equally apply in both hydraulic and electrical cases to working metallic circuit or independently of earth.

A given volume of water from a limited reservoir may be raised, say 100 feet, and exert mechanical power in its fall to the primary level, this action being kept up continuously as long as the motor power is efficient.

A given battery power may produce, not a difference of water level, but a strictly analogous difference of electrical potential, forcing a given current through a certain resistance, or doing equivalent work, and returning like the water, to be again forced up continuously as long as the motor power is efficient.

In both cases, the *direction and quality* of current are the same, tested at any point, or at either side, and in both cases, the direction may be apparently reversed by a similar reversal of the testing apparatus.

A reversal in one case, is a simple matter, only admitting of a to or fro motion.

A reversal in the other case is identically similar if we first of all define *fairly* what we mean by a direction of current; but failing this, we stumble upon a mysterious duality, where positive and negative qualities are inherent in every part of the circuit; so that we may say in clumsy empiricism, a — current is proceeding from this side, and a + current issues from the other side, and this difference equally subsists where at the middle or any other part of the circuit, given testing apparatus may be turned round.

The subject is a very tempting one for me to enlarge upon, but I forbear in the hope of testing this one point.

It may not be agreeable for Mr. Fleeming Jenkin to learn of such amateurs as Mr. Johnstone or myself; but if in describing present hypotheses, he has identified himself with the idea that "all bodies contain an indefinite amount of a neutral fluid, which is not electricity, but from which equal quantities of + and — electricity may be obtained by decomposition, whenever electricity is brought into evidence, . . . and that it is improbable that either electric fluids have any substantive existence," that is, any material basis, then I do maintain that such estimates of the phenomena, are invalid and imcompatible with our present state of knowledge.

Sam. E. Phillips.

IN A CYCLONE.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: A short account of the troubles that befel us in a cyclone from Bombay to Aden may interest some of your readers.

It was a fine bright evening when the ss. "John Pender" left her moorings at Bombay and entered upon a voyage memorable to us all.

There is a self-satisfaction in reviewing past discomfort or misery which has been ranked by many as one of the choicest mental pleasures we possess; but it is very questionable whether the prospect of this after-taste would have been sufficiently alluring to tempt us into that cyclone.

For two days the weather was fine but on the third

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—Sunday—a change set in. The sky, hitherto so bright, became dark, and, like the barometer, lowering, and as we watched the shortening mercurial column our faces lengthened in proportion, doubtless, on Mr. Darwin's principle of emotional antithesis. The glass is at such a time the focus of all observation and discussion.

The wind, hitherto favourable, came abeam, and steadily increased in strength, so that on Monday morning a gale was blowing from the N.W.

It then became apparent to those initiated in nautical matters that we were in the region of a cyclone.

The theory of cyclones, embracing as it does motions of both translation and rotation, is one of great interest; but, when studied practically, I feel sure that the subject is devoid of all interest whatever, or, in transatlantic phrase, it is one of the most or'nary physical phenomena that can be imagined. We felt, in truth, even at this early stage of our experience, that the study of cyclones could be conducted vicariously with far greater advantage than *in propria persona*.

Every preparation was soon made to meet the coming storm. In technical language, all things soon became "snug." I do not know the name of the gentleman who first nautically applied this glaring misnomer. If I did, I should revile him absent, or seriously remonstrate with him if present. It is difficult for the Christian inexperienced mind to realise how "snug" your cabin may become on the Indian Ocean in the end of May after every chink by which fresh air can find ingress there has been hermetically closed. Suffice it to say that an advocate for the healthful effects of window opening at night would have found powerful arguments ready to his hand had he but been with us.

The wind and sea rose as the day wore on, and the ship was several times in a critical condition through the fracture of the chains connecting the rudder with the wheel on the bridge. The after-wheel was, however, promptly brought into play on each occasion until the chain could be repaired. This source of refuge was removed later on, when a wave, towards evening, broke over the stern, and completely smashed the wheel there. Very fortunately the chains did not break again.

During the night it rained very hard, and rather than remain on deck drenched with rain and spray each one sought for himself a cool nook below where to await the tardy advent of the drowsy god.

The climax of the hurricane was reached next day. At 6:30 a.m. myself and one or two more who had succeeded in getting to sleep in the saloon cabins were awakened by a crash and a deluge of water. It is not pleasant to wake up suddenly at any time; but it is most decidedly objectionable to be roused with a loud crash only to find your bunk converted into a swimming bath, and catch the sound of many waters among your boxes, or gurgling in the cavernous recesses where you but yesterday fondly imagined your dry clothes and valuables safe from the spoiler. On rushing out of our cabins as fast as the water up to our waists would permit, we found that the after part of the ship was almost a wreck. Boats, deck-house, awning stanchions, boom machinery, all mingling, fell.

All combined to form a dismal picture. The dark, heavy sky; the mountainous waves up whose steep sides spray was dashing in mad career—up, up to the curling summit, and, swelling for a moment the turbulence there, descending again the opposite face until the whole surface seemed wrapped in foam; the ship plunging heavily, lifting her bows higher and higher until they rested on the summit of a wave, while behind her appeared a dense, impenetrable wall of water hurrying away; the unaccustomed forlorn look of the quarter-deck. Hundreds have seen such sights as these, some not unfrequently; but once seen they could hardly be forgotten.

It was not long before the gaps left in the deck by the loss of the "companions" were securely bridged over with planks and tarpaulins, and now commenced our real discomfort. Few could boast of so much as a dry shirt, and the costumes adopted became simple, but scarcely fashionable, consisting for the most part of a singlet and pair of unmentionables, the latter tucked up to the knees. Boots and socks were unanimously voted encumbrances, and everybody was delightfully wet and uncomfortable. Nothing hot to eat or drink was to be had that day, as a fire could not be kept alight in the galley, so we consoled ourselves by munching biscuits and hoping for better weather. Night time was, perhaps, the worst. Even if the weather be not cold, damp clothes are not conducive to sleep, and if we tried to dry our clothes by standing before the furnace-doors in the stoke-hole, a shower of spray would come down and drench us just as we fancied we were nearly dry. Locomotion became a labour, for the ship rolled just 45°, and with slippery decks incessantly washed by seas it became necessary to proceed with caution and to hold on. Many casualties occurred from falls or upsets from incoming seas. Fifteen men suffered from blows and contusions more or less severe.

On the next day (Wednesday) the gale was still high, and the sea very heavy, but the squalls were not so frequent. Great rejoicing took place at the manufacture of an infusion said to be tea. Of course it was a clear case of boiled tea leaves; but the strong liquid produced equalled in our partial opinions the best Epps's cocoa, in grateful and comforting qualities. The cook, it seemed, had discovered the art of keeping a range alight, and a large tin teapot boiling—kettles being superfluities—with the water washing about the galley. This eminent functionary rose to be considered a magician at once.

During the evening and ensuing night the gale began to abate, and on the following morning the sea had sufficiently subsided to allow the ship to be turned round without risk. This was done, and she was soon scudding before the wind towards the shelter of the Arabian shore. From that moment the weather began to improve, and later on in the day the luxuries of a bath, and hot salt pork, both under difficulties, were duly appreciated.

In two days' time we were able to dry all our wet clothes, books, &c., and the decks seemed only to require the stool, desk, and hammer, to make an auctioneer's assortment complete. Mildew and iron-rust had worked sad havoc among our goods and chattels, many of which had to be consigned to the depths in consequence.

It is needless to mention that it was with no regret that we anchored in Aden after fifteen days tossing on the ocean, and the advent of the washerman in due course gave great satisfaction.—Yours, &c.,

A. E. K.

Aden, 19th June, 1881.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices July 27.		Business Done Week Ending July 27. Highest.		Lowest.	
Anglo-American	51¼,	52¼	.....	52¼	.....	51¼
Do. Preferred	82½,	83½	.....	83	.....	82½
Do. Deferred	25,	¼	.....	25½	.....	24¼
Brazil Submarine	10¾,	¼	.....	10¾	.....	10¼
Cuba	9¼,	10¼	.....	10	.....	9¼
Do. Preference	16½,	17½	.....	—	.....	—
Direct Spanish	4¼,	5¼	.....	5	.....	4¼
Do. Preference	13¾,	14¼	.....	13¾	.....	13¼
Direct United States Cable	10¼,	¼	.....	10¼	.....	10¼
Eastern Telegraph	10¼,	¼	.....	10¾	.....	10¼
Do. 6 per Cent. Preference	12¼,	13¼	.....	13¼	.....	13
Do. 5 per Cent. Debentures, 1899	106,	109	.....	—	.....	—
Eastern Extension	11,	¼	.....	11¼	.....	11
German Union	9¼,	10¼	.....	10¼	.....	9½
Globe Telegraph and Trust Company	6¼,	¼	.....	6 11-16	.....	6 9-16
Do. Preference	12¼,	¼	.....	12¼	.....	12¼
Great Northern	12¼,	13¼	.....	—	.....	—
Indo-European	28,	29	.....	28½	.....	28½
Mediterranean Extension	2¼,	3¼	.....	3	.....	3
Do. Preference	9,	¼	.....	9¼	.....	9 5-16
Reuter's	12,	13	.....	12¼	.....	12¼
Submarine	285,	295	.....	—	.....	—
West India and Panama	1¾,	2¼	.....	2	.....	1¾
Do. 1st Preference	7,	¼	.....	7¼	.....	7¼
Western Brazilian	8¼,	¼	.....	8¼	.....	8¼
West. Union 7 per Cent. 1st Mortgage	125,	130	.....	—	.....	—
Do. 6 per Cent. Sterling Bonds	106,	110	.....	—	.....	—

TRAFFIC RECEIPTS FOR JUNE, 1881.

Companies.	June, 1881.	June, 1880.	Increase.	Decrease
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	£2,700	3,147	—	44
Direct Spanish Telegraph Company	1,456	1,277	179	—
Direct United States Cable Company	16,080*	6,520†	9,560	—
Eastern Telegraph Company	40,074	42,522	—	2,448
Eastern Extension Telegraph Company	29,339	29,100	239	—

* At 2s. per word. † At 1s. 6d per word

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

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THE PARIS EXHIBITION.

On Monday, the first day of August, the people of the French capital will inaugurate what promises to be a quite new sensation. Although an ingenious nation, France does not yet stand quite foremost in the ranks of science. But what France has been and what she aspires to become are two different things, and nobody can be surprised that, having provided herself with the appliances of war, she is taking some recreation and honour in the arts of peace. She has at all events gone into this quite unique experiment in the exhibition line with a zeal and perseverance which is worthy of all praise. A Congress of Electricians of the whole world is to be preceded by an Exhibition of the Works of Electricians of all ages. The ceremonial will, of course, be imposing, and in doing honour to its foreign guests the national spirit will take much credit to itself and feel immensely elated. A hearty and even overpowering welcome may be counted upon, and our countrymen will almost certainly have a good time.

The idea of the Exhibition is certainly original and novel. Exhibitions there have been in this country, and probably elsewhere, of local invention and appliances connected with electrical science; but nowhere until now has there been anything approaching an international collection. Nor perhaps, at any time could such a collection have been more opportune than just now. Applied electricity is taking what may fittingly be called a new departure. From being mainly confined to the purposes of the telegraph and the arts, it has latterly shown promise of being largely applicable to illumination, and for the performance of mechanical work. The possibilities of telegraphy are by no means yet exhausted, and the bringing together of manifold apparatus, tried and untried, from every quarter cannot fail to lend an impetus to telegraphic achievements in the near future. But the objects that will be furthered most will probably be electric lighting and electric motors. Numberless devices will be open to actual inspection which have only been partially understood by pictorial or printed descriptions. Moreover, as provision is made for patent rights not being jeopardised by premature disclosures, we may hope to see at once many devices which otherwise would not have come to light until some indefinite future. Thus a correct estimate may be formed not only of what has already been done anywhere and everywhere but also of what is likely to be done by and bye. For the benefit of readers of *The Electrician* who may not be able to visit Paris we have despatched a special reporter, and we purpose giving the fullest possible account of everything worthy of special notice.

It is not without some misgivings that we look forward to the figure our own country will cut at this Exhibition. Beyond all question nobody is to blame for this but the present Government. With or without sufficient reason it has elected to be the one solitary instance of refusal to take any official part in the scheme. It will not contribute to the expenses; we believe it does not even pay the expenses of the gentlemen lately announced as the English commissioners, nor does it help or countenance any guarantee fund to cover exhibitors' expenses. What is worse, it delayed making up its mind so long that everyone was left in uncertainty as to what would be done or not done until it was almost too late for anything to be done at all. The Society of Telegraph Engineers energetically set to work so soon as it was free to do so, and what could reasonably be expected has actually been accomplished. But the prolonged uncertainty has had its effect, and we believe that even now the exhibitors have not united in any common effort or mutual assistance financially. The British section—the section representing a nation which is first in applied electricity, and is hardly second to any in electrical science—cannot be quite a failure; but it will exceed our hopes if it be a great success compared with what it might have been under more encouraging auspices.

The exhibits from the Post Office will, however, largely contribute to redeem some of our anticipated shortcomings. A considerable quantity of apparatus has been—much to his credit—forwarded by the Postmaster-General, and they are in the charge of the competent hands of Mr. Kempe. This department also commissions its Chief Engineer and Electrician to represent it at the Congress, the latter, we believe, also attending the Exhibition.

Touching the subsequent Congress, we shall speak more at length hereafter, when its object is somewhat less obscure than it is at present. The French authorities—or perhaps we should rather say M. Cochery—have decided to keep the meetings private, and to exclude newspaper reporters. It is not stated that the members are sworn to secresy, nor does it appear that the proceedings are to be of such an occult or diabolical character that the light of day may not shine upon them. Our readers may rest assured that, official prohibition notwithstanding, the fullest information will be forthcoming, and we can confidently promise that *The Electrician* will not be behind its contemporaries in retailing that information for its readers.

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ELECTRIC EXCITATION OF NERVES AND MUSCLES.

Electricity is now in regular use for exciting the nerves and muscles of the body, but as yet there have been no good means of graduating the current in such a way as to render the observations of different physiologists comparable with one another. The result is that no satisfactory check can be put upon the results of experimenters, and no accurate comparison can be made of their data. At present it is only stated that the current is weak, strong, or moderate, and even the same experimenter does not know whether he is employing precisely the same strength of current in two successive operations.

The induced current is generally employed, and the energy of it depends on a great number of factors, which are ever varying during the action of the apparatus, such as the potential of the battery, its resistance, the number of vibrations of the interrupter, the long or brief closing of the circuit, the perfection of the contacts, and so on.

In the Du Bois Reymond induction coil the graduation of of any given current is very well effected by gradually withdrawing the induced bobbin from the inducing bobbin in such a manner that the energy of the induced current decreases without discontinuity from a maximum to zero. If, then, a means could be devised of giving a definite value to the inducing current, which could be easily reproduced, the problem would be practically solved. This has been attempted by M. d'Arsonval, the well-known French physicist, and the following is his arrangement, which has the advantage of reducing the excitation to a purely mechanical effect free from chemical decomposition of the fluids in the living tissue, and consequent modification of its excitability.

The apparatus in question consists of a battery, a condenser, a chariot induction coil of Du Bois Reymond, and an oscillating Morse key serving for interrupter.

The battery is composed of 20 pairs of Gaiffe's medical battery with bioxide of manganese and chloride of zinc. The electromotive force can be varied from 1½ to 30 volts, and it serves to charge the condenser. The latter consists of a microfarad divided into tenths, and it is placed in the base of the induction coil. The oscillating Morse key puts the condenser alternately in connection with the oscillating Morse battery and the fixed bobbin of the coil. It is similar to that employed by M. d'Arsonval to demonstrate by aid of the telephone the presence of a continuous current in the nerves and muscles. (See *Comptes Rendus*, April, 1874).

M. d'Arsonval, therefore, employs for his inducing current the discharge of a condenser of known capacity charged to a known potential. The quantity of electricity put in play is, therefore, mathematically ascertainable. The instantaneous inducing current, which may be likened to a current which begins and ends, gives birth in the secondary circuit to two instantaneous currents of equal quantity but opposite directions, which, consequently, annul each other in a chemical sense.

The excitation, therefore, reduces itself, in M. d'Arvonsal's opinion, to a purely mechanical effect of electricity, which will always be the same for the same distance apart of the two bobbins and the same value of the inducing current. Since he has employed this device M. d'Arsonval has obtained many interesting results, some of which we hope to lay before our readers on a future occasion.

THE SCINTILLATION OF STARS AND OF THE ELECTRIC LIGHT BETWEEN CARBON POINTS.—*L'Electricité* observes that on the occasion of a recent balloon ascent several electric lights were observed to scintillate like the fixed stars, though in a less degree, whilst the light from gas burners had a much more steady appearance. Our contemporary points out that the effect may be accounted for by the small dimension of the luminous point in the case of scintillating lights. The position of this point on the retina would be wholly displaced by a very slight variation in the refracting power of the atmospheric layers through which the luminous rays pass; and the effect thus produced would be very different to that which occurs when the image on the retina is distributed over an appreciable area.

THE SPARKING OF CONDENSERS.

Some interesting experiments, from a physical point of view, have been made recently by M. Villari on the heat developed by the sparking of condensers on being charged. The spark which is produced on charging a condenser is termed the exciting spark by M. Villari, and that produced on discharging it is termed the conjunctive spark. It is the former, however, which M. Villari has studied in these researches.

In order to do so he constructed a special thermometer consisting of the charging contact enclosed in glass bulb, which was supported on ebonite so that it could turn round a horizontal axis and close the circuit of a battery, to which it was connected at the moment of discharge. The exciting spark exploded into the ball, and the heat developed was measured by the displacement of a glycerine and water index contained in a vertical glass tube annexed to the ball.

In experimenting with this contrivance, M. Villari has found that *the heat developed by the exciting spark is nearly proportional to the square of the charges.*

This law, however, is not a general one, for the experiments are complicated by various phenomena. In the first place it is necessary to take into account the fact that the glass of the condensers, which were Leyden jars. does not always retain the electric charge well. Some jars, indeed, would not take a charge at all. It was necessary to select these and varnish the glass with shellac.

In the second place, while employing powerful charges, M. Villari found there were internal discharges which deprived the exciting spark of its proper energy.

Finally, the jointed contacts within the bulb not being in perfect contact, small sparks were produced there, developing heat which could not communicate itself to the air of the bulb immediately, and, therefore, disturbed the indications. M. Villari, therefore, fixed the bulb in one place, and soldered the joints of the contacts while providing that they can be brought together or withdrawn for sparking purposes.

With this improved appliance, and taking every precaution, M. Villari finds that with platinum discharging points :—

1. *The heat of the exciting spark increases more rapidly than the third power of the charges for a small potential.*
2. *It increases as the square of the charges for a mean potential.*
3. *It increases nearly as the charges for a very high potential.*

It is probable that the interior discharges conduce to these results; as they are small for small potentials and augment rapidly with the potential.

M. Villari has also studied how the heat increases when the quantity of electricity is increased, the electromotive force remaining constant. He finds that the heat of the exciting spark increases a little less quickly than the charge when the potential is constant; more exactly when the charge increases in the ratio of 1 to 1·77.

He also varied the potential of a constant charge which he had accumulated in a variable number of jars, and demonstrated that :—

1. *The heat of the exciting spark increases more rapidly than the potentials when they are small.*
2. *That it increases as the potentials when they are mean.*
3. *That it increases very little, or even decreases, when the potentials increase if these are very high.*

These effects depend also on the internal discharges. In limiting himself to small potentials he found that, if the potential was increased from 1 to 2 (12 of his charges were at first distributed to 24, and then to 12 equal jars), the heat of the spark increased in the ratio of 1 to 3·81.

To sum up, for small potentials we may say that when in a condenser we increase at the same time, and in the same proportions, the charge and the potential (as happens when we increase the electric mass in the same battery) in the ratio of 1 to 2, the heat of the spark ought to increase, according to the preceding results, in the proportion of 1 to 1·77 × 3·81, that is to say, from 1 to 6·74. This indirect method permits (when we know the heat developed by the spark produced by a charge of 1) of determining that which will be produced by a charge 2, accumulated in the same condenser.

M. Villari's experiments show that a complete accord exists between the quantity of heat determined by direct measure and that which is calculated by the indirect method. It also follows that for a determined potential of a given change, the heat developed by it is divided between the internal and the external exciting spark, in such a manner that, in the latter, it proportionally increases with the square of the charge, and in inverse

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ratio to the surface of the condensers. We may also say that the heat developed by the spark is proportional to the quantity of electricity multiplied by the electric density, or still better, is proportional to the quantity of electricity for the fall of potential. These laws, which may be called the limiting laws of the spark, are the same laws which hold for metal wires.

ON THE CONVERSION OF MECHANICAL ENERGY INTO HEAT BY DYNAMO-ELECTRIC MACHINES.*

BY G. F. BARKER.

The author thinks that the applicability of the dynamo-electric current, not only to the production of light but also of heat and for the transmission of power, will have to be before long seriously considered. The amount of heat obtainable from dynamo machines worked on a commercial scale is one therefore of considerable importance; and as the energy of the electric current is always dissipated in heat, the only condition required is to localise the resistance of the circuit where the heat is to be produced, as, for instance, by means of a coil of wire of high resistance, which may be placed in an apartment to be warmed, or the current may be employed to heat air or water, which is then circulated as the heating medium. Sir William Thomson is referred to as having proposed the latter mode of heating before the parliamentary committee which sat on the subject of supplying light by electricity. He proposed to transmit the electric current through copper tubular conductors, also conveying water, when by diminishing the thickness of the conductor, its temperature would rise and also that of the water, which might then be distributed through the streets of a city.

The experiments detailed in the paper were made on a Siemens B dynamo machine. The driving pulley was 8 inches in diameter and 3 inches wide. The resistance of the machine at rest was 0·68 ohm. It was driven by water power at speeds varying from five hundred and sixty to eight hundred and forty revolutions per minute. The belts used were of 1¼ inch, 2 inches, and 3½ inches width, the latter for the highest velocity and low external resistance. In the circuit of the machine was included a double-coil tangent galvanometer, a heating coil of German silver wire, and the conducting wires. The coils of the galvanometer were single turns of thick copper wire, offering no appreciable resistance; its constant was 5·7 webers per second. The German silver wire on the heating coils was of 0·035 inch diameter, and was wound in grooves cut on the surfaces of wooden cylinders, the lengths gradually increasing so as to give resistances varying from 0·2 ohm up to 6·84 ohms. The combined resistance of the galvanometer and leading wires was 0·05 ohm. The calorimeter was a glass battery-jar containing the water to be heated, the temperature of which was measured.

The plan of operations was as follows: 10 lbs. of water were weighed into the calorimeter, the heating coil was introduced and the time and temperature were noted. The machine was then run for five minutes, during which interval its speed was counted two or three times, and the deflection of the galvanometer frequently noted. When at the end of the experiment the machine was stopped, the water was agitated and its temperature noted. From these data the current strength and the evolved heat were calculated. No dynamometer was at hand to measure the power consumed by the machine, but the experiments of Dr. Hopkinson were relied on, proving that 87 per cent. of the power employed in this machine appear as electrical energy in the circuit.

The first series of five experiments was made under similar conditions, except that the resistance of the heating coil was gradually increased.

No.	Speed.	Resistance.		Deflection.†	Temperature.	Time.
	Revolutions per Minute.	Heating Coil,	Total (Ohms.)	Deg.	Fah. Degs.	Mins.
1	690	0·204	0·934	87+	76—82	2
2	840	0·310	1·049	87	81—82	2
3	820	0·420	1·150	86·5	80—128	5
4	840	0·610	1·340	86	77—132	5
5	840	1·080	1·810	83·5	81—130	5

* "Proceedings of the American Association for the Advancement of Science, vol. xxviii., p. 160."—From *Abstracts of Papers made by Institution of Civil Engineers.*

† It would doubtless have been better to shunt the galvanometer in these cases, so as to bring its deflections near to 45 deg. The error, however, tends to make the final result too low, but in no case too high.

From this table the following one of calculated results is obtained:—

Number.	Tangents of Deflections.	Tangents × 5·7.	Webers × Total Resistance.	Webers. × Volts.	Volt-Webers × 44·25 ÷ 33,000	10 lbs. × Rise Temp. ÷ No. Minutes.	Heat-units × 772 ÷ 33,000
		Webers.	Volts.	Volt-Webers.	HP.	Heat-units per Min.	HP.
1	19·081	108·76	101·59	11,048	14·82	30	0·702
2	19·081	108·76	113·11	12,302	16·12	85	1·989
3	16·341	93·14	107·12	9,976	13·38	96	2·246
4	14·301	81·52	109·24	8,905	11·94	110	2·574
5	8·777	50·04	90·55	4,530	6·09	98	2·293

From this table it may be remarked that the energy communicated to the water as heat reached its maximum in the fourth experiment, in which case the resistance of the external circuit (0·61 + 0·05) = 0·66 is equal to that of the electromotor 0·68. According to the law of heat production, since these resistances are equal, one-half of the energy of the circuit should appear as heat in the machine and the other half in the calorimeter, whose heating coil represents nearly the whole external resistance, whereas the amount is really 21·56 per cent. of the total energy of the current. The figures show that the electromotive force is nearly constant, and since the current strength diminishes with the increase of total resistance, the total energy of the circuit (Volt-Webers) varies with the current strength. The heat in the calorimeter rises with the resistance until this equals that in the machine and then diminishes again. The total current effect is E C, and since E = C R, C^2 R represents the total heating effect. The heat only varies with R when C is constant; when C varies the heating effect increases and diminishes in a much more rapid ratio, as the figures in the table show.

In a second series of experiments the resistance of the circuit was so considerable that the machine could be driven with a 1¼-inch belt. The table of results is given, and a second table in which is calculated for both series the per centage of work utilised under the conditions of the experiments. From these calculated results it appears that the percentage ratio of the theoretical to the total effect of the actual energy obtained in the calorimeter to that of the entire circuit, and also of useful effect, continue to increase throughout with the resistance of the circuit, or better as the ratio of the resistance of the external to the internal circuit increases. As the maximum work obtainable as heat is reached in the fourth experiment of the first series, and as the percentage of efficiency rises throughout the experiments, the absolute and relative efficiencies of the machine are values of a different order. The heat energy obtainable in the calorimeter is one thing, and the proportion of current energy thus utilized is another.

Entirely different experiments would be required to show the conditions under which most energy can be utilized in the external circuit; in these the current strength must be the same and the total resistance the same, while the ratio of the external to internal resistance may be varied, either by using a machine whose internal resistance may be varied, or by adding to the external circuit and increasing its electromotive force to compensate for the increased resistance.

Experiments were made in which a gallon of water was raised from 87° Fahrenheit to the boiling point in sixteen and a half minutes by sending the current through a coil of 2 ohms resistance.

Finally, with regard to the relative cost of treating by electricity and other means, the author finds that calling the cost of 100 heat-units produced by the direct burning of coal 1, the cost of heating by gas directly is 65 (with coal at 4 dollars a ton and gas at 2 dollars per 1,000 cubic feet); by the thermo-electric current, 200; by the dynamo current worked by steam power, 400, and worked by a gas engine, 450. The results may be tabulated as follows:—

RELATIVE COST OF 100 HEAT-UNITS.

Method.	Price.	Heat units.	Cost.	Ratio.
A. By combustion—				
Of coal	16s. 8d. per ton	1 lb. = 8,700	·002	1
Of coal-gas	8s. 4d. per 1,000	1 cub. ft. = 150	·130	65
B. By electricity—				
a. Dynamo machines—				
One driven by steam, 1 HP. =	2d. (4 cents.)	1 HP. = 2,500	·100	400
Two driven by gas engine, 1 HP. =	2·15d. (4·3 ,,)	1 HP. = 2,500	·900	450
b. Thermo-battery, coke	16s. 8d. per ton	1 lb. = 250	·400	200

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NEW SYSTEM OF TELEPHONY.

BY A. E. DOLBEAR.

The Receiver.—This consists, in its simplest form, of two metallic discs about two inches in diameter, so mounted as not to be in metallic contact, and this is effected by turning a flange in a hard rubber case so that they are kept apart by it. A cap is screwed down upon each plate, one of them having a small hole in the middle of it to listen at; the other is a larger one, having a knob turned upon it for conveniently holding it in the hand. Through the middle of the knob a screw is sunk which touches the back plate and serves to adjust it to the best position relative to the front or vibrating plate. The back plate is thus fastened at both edge and middle, which prevents it from vibrating, while the front plate is only fast at its edge, leaving the middle free to vibrate. Each of these plates is in metallic connection with the induction coil so as to be its terminals. When thus connected, and one makes and breaks connection in the primary circuit a click may be heard by one holding the receiver near to the ear. If a Helmholtz interrupter be employed to make and break the primary circuit the pitch of the fork can easily be heard, and with a *Reiss transmitter*, or other suitable one in the same place, any kind of a sound will be reproduced.

The explanation of this is easily understood. The electromotive force generated by induction in the coil changes the two terminals in the receiver, one positively, the other negatively; they therefore attract each other.

One of them is free to move, while the other is rigid. The middle of the freer plate consequently moves slightly towards the other whenever they are electrified, and *in so doing spends the energy of the electricity*, while its elasticity brings it back to its place. It is not essential, however, that both of these terminal plates should be connected to the induction coil, for if only one is connected the recurring charges will cause the free plate to vibrate, for a charged body will attract any other body, so if the connection be to the back plate it will attract the front one and make it move, and if the connection be to the front plate it will attract the back plate and approach it. The effect will be increased by putting the finger upon the terminal that is free; not because it *makes a ground*, as it is termed in electrical science, or completes an electrical circuit, for if the individual listening be as perfectly insulated as glass or hard rubber can make him, the sound is as loud as if he stood on the ground; but the individual becomes electrified by induction. It is the same as enlarging the terminal would be. Consequently, receivers are made having only one wire terminal, the other plate being connected by a conductor to a metallic ring upon the knob, and this receiver is as efficient as the other.

Electricians will recognise in this structure what is technically known as the *air condenser*, and the mutual attraction of the two plates has been employed as a means of measuring electric potential.

When the two plates of Epinus's condenser are in metallic contact no sounds whatever can be produced by it, but if they are separated by a thin film of air they will reproduce speech. In the first case the electricity passes from one plate to the other without doing work or changing its form; while in the latter, its form is changed and work is done, and between the best conductors, such as silver and copper and the perfect non-conductor air, there are all degrees of conductibility, and whenever electricity spends its energy upon an imperfect conductor it results in heating it; that is, in molecular and atomic vibrations. Consequently an undulatory current from an ordinary transmitter, when sent through an imperfect conductor, will set up sound vibrations in it which may be appreciated by the ear. Let, then, any poor conductor, like a disc of carbon, a sheet of paper or of gelatine, or such chemical substances as ammonium chloride, be placed between the terminal plates, and an undulatory current sent through them will result in sound, and speech may be reproduced.

Among the earliest of my experiments, made while developing this method, was to attach one terminal wire from an induction coil to the outer coating of a Leyden jar, taking the other wire from the coil in one hand, and applying one ear to the knob of the jar. Every word spoken at the transmitter was distinctly heard, but the prickly sensation due to the electricity was too disagreeable. Another receiver, not less curious than the Leyden jar, was found in the pair of insulating handles made for the medical application of electricity. When these were connected to the coil wires, and one held in each hand by the wooden part, while the metallic ends were placed at the ears, any kind of a sound at the transmitter was heard without any difficulty, but of course the same sensation was felt as with the jar. Many forms of condensers have been employed with capacities too small to measure up to two micro-farads, and these in all sorts of relations, charging the plates from batteries, from Holtz machines, charging the line as in cable works, &c., all of which give results that differ only in degree.

The Transmitter.—The transmitter is substantially the same as the one invented by Reiss in 1861. His consisted of a cubical box about five inches on a side, having an opening on one side to talk into, and another one on top, across which the diaphragm was fastened. A pin of platinum was glued to the middle of the membrane, and connected by a wire to a binding screw. A V-shaped wire with platinum point touched upon the platinum of the membrane, and with its binding screw served to complete a galvanic circuit. This one differs from that of Reiss only in making the chamber smaller, making the connecting wire on top I-shaped, and substituting carbon or other suitable substance for the platinum; but the platinum does very well. It is a matter of some surprise that the old transmitter is still spoken of as a *make and break* circuit, and that it can only transmit pitch, whereas, whether it breaks or not when a sound is made in it depends solely upon the intensity of that sound, just as with the Blake transmitter. If one talks gently to the original Reiss transmitter, it not only does not break, but it transmits speech with all its qualities.

Accompanying the transmitter is an induction coil, and as the working of the receiver depends upon electromotive force and not upon current, it is necessary, if a coil be used to raise the electromotive force, to have one with many more turns than is needed with the magneto receiver, and the best results have been obtained with a coil having a resistance of four or five thousand ohms, but it is probable that this will be reduced. On account of the high electromotive force a better insulation is needed than ordinary telegraph lines give when the induction coil is at the further end of the line, but if it is at the receiving end, and a low electromotive force is employed in the primary, then ordinary insulation will answer. Again, the electromotive force being high, inserted resistances do not so markedly decrease the efficiency of the instrument, as in the case with the magneto-telephone. For instance, the articulation is perfect and loud enough with a resistance of fifty thousand ohms, a resistance equal to five thousand miles of common telegraph wire, and it may be heard through a resistance of a million ohms, practically an infinite resistance. If one of the terminals of a receiver be charged in any way, the reaction between the two plates will be stronger than it will be without. Let, then, one terminal be attached to a knob of a Holtz machine that is kept charged by rotation. The sounds will be heard much louder, and any other source of electricity with high potential will answer the same purpose. Hence a battery of a large number of cells may be substituted for the Holtz machine, and one of the terminals of the battery may go to the ground, though this is not essential. This arrangement will keep the terminal plate charged to the potential due to the chemical relations and number of cells in the battery. If the battery be placed in the line wire it will keep both ends of the line charged. A Volta pile may be substituted for the battery in either place, and so may a charged condenser of any capacity, the electrically-charged terminals in this system acting in a way analogous to the permanent magnets in the magnetic system.—*Scientific American.*

DIRECT UNITED STATES CABLE COMPANY (LIMITED).

The eighth ordinary general meeting of this Company was held at the Cannon-street Hotel, on the 28th inst., under the presidency of John Pender, Esq., M.P.

The SECRETARY AND TRAFFIC MANAGER (Mr. J. W. Fuller) having read the notice convening the meeting,

The CHAIRMAN said: Gentlemen, you have had the report in your hands for some days, and I presume you will take it as read [hear, hear]. Before I ask you to approve of the report I will make a few remarks. The report, as you will observe is, all things considered, a satisfactory one. The revenue for the half year to the 30th of June last, after deducting out-payments, amounted to £93,581; and the working expenses, including interest on debentures and income-tax, absorbed £26,871, leaving a balance of £66,710 as the net profit of the half year, making, with £3,116 brought from the previous half year a total of £69,826, which has been appropriated as follows:—Interim dividend of 5s. per share to the 31st of March last, £15,177 10s.; final dividend of like amount now proposed £15,177 10s., carried to reserve fund £32,292, and carried forward £7,179. The revenue for the half year is larger by £11,432 than in the corresponding six months of 1880, but this increase affords no reliable comparison, owing to the competition tariffs in force in 1880. The working expenses at London and stations, as shown by abstracts A and B, are so very nearly the same as at this period last year that no comparison of the items need be made. It may be mentioned, however, that these expenses have been maintained at their present figure, in spite of a very large increase in the Company's service [hear, hear]. The items of law charges in the United States and Canada, and special travelling expenses were incurred by proceedings taken to protect the Company's

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agreements with the American land line companies. The cost of two repairs of the Company's Torbay Rye Beach cable (the interruptions of which were notified in the directors' report to the meeting of February 25 last) amounted to £2,496 only, and this sum has been charged to the reserve fund, which now amounts to £235,000. On these two important points we have good reason to congratulate ourselves, namely, the increase of the reserve fund, and the very small amount of expenses incurred for repairs during the past year. Before I put the resolution I wish to make a few remarks on the present position of Atlantic telegraph companies. At the present moment, when so much has been said about the monopoly of the submarine system and the competition which is likely to arise owing to the new element introduced into transatlantic telegraphy—namely, the Americans working submarine cables of their own—I think it right to say a few words on these subjects. I observe that the Americans take credit for the reduction of the tariff to one shilling, which will come into operation from the 1st of August next. I may mention, however, that this question of a shilling rate has been long under consideration by the respective Atlantic telegraph systems, and what has prevented its earlier introduction has been that the attention of both the Anglo and the Direct Companies has been drawn to consider other questions affecting the interests of Atlantic telegraphy. It is only lately that our cable has been duplexed, affording us in fact the carrying capacity of a second cable; and I may say that without the adoption of the duplex system it would have been impossible to have introduced a shilling rate so as to have given anything like an adequate return to the shareholders. We are now about to give this shilling rate a fair trial. The Anglo Company's four cables are duplexed; this Company's cable is duplexed, and the French Company are about to duplex their cable, so that our combined carrying power will be equal to twelves cables. I remember in the early days of telegraphy it was considered the most visionary thing possible when it was mentioned that before the life probably of the youngest person among us had expired there would be a dozen cables in the Atlantic. To-day I may say that there is virtually the working power of twelve cables in the Atlantic. The charge of monopoly which has been so frequently brought against the Atlantic telegraph system, and made so much of not only in this country, but also in America, is entirely fallacious. Take the system of submarine telegraphy and compare it with the land system both in America, England, and the Continent of Europe. When the first Atlantic cable was open in 1866 no message could be sent for less than £20. A gradual reduction has been made, and in the meantime the development of transatlantic traffic brought about a competing line called the French Atlantic Company. After a time this last named company amalgamated with the Anglo-American Company. This was followed shortly afterwards by the establishment of this, the Direct Company, when the rates were reduced temporarily to one shilling. At that time there was no duplex system in existence, and it was found that a shilling rate would not pay. The rate was then raised to 3s., and notwithstanding this increase, for a period of nearly two years the Direct Company paid no dividend. You are all aware of the circumstances under which the present board became managers of the Company. At that time there was a great deal of talk as to the Anglo and Direct Companies being amalgamated. I always objected personally to this, as I felt that the public would be better served by having the opportunity of dealing either with one or the other company. At the same time considerable economies were effected by the joint-purse arrangement which was then made between the Anglo and the Direct Companies, an account of which was laid before you. The Atlantic system of telegraphy appears to have a particular fascination for contractors and speculative combinations, for no sooner had the arrangement between the Anglo and the Direct Company been completed than it was followed by the establishment of the new French Company. Competition arose again, and the rates again went down—the Direct Cable to 1s. 6d. and the Anglo's cables to 6d. respectively; but the loss was apparent, amounting as it did to a sum equal to about £600,000 per annum. I believe that the real loss was something like £200,000 to the respective companies while this competition lasted. This was so disastrous, not only to the French Company, but to the English systems, that an arrangement was come to with the French Company after considerable negotiation, and that arrangement resulted in a division of receipts, and at the same time a reduction of 1s. was made in the tariff, namely from 3s. to 2s., showing that through all the arrangements made with these submarine systems the public has never suffered, but has always been the gainer [hear, hear]. Meantime the growth of telegraphy has been gradually developing, and we now hope that from the adoption of the 1s. tariff the increase of business will be such that if not immediately, still within a short space of time we shall have sufficient returns to enable us to continue at the shilling rate. I have thus shown you that the policy of the Atlantic submarine system, from the time of its inauguration to the present moment, has been one of steady reduction of tariffs and corresponding benefit to the public [hear, hear]. This, I think, proves most clearly that the monopoly—if people choose to call it monopoly—has been used in the most liberal spirit, so far as the public are concerned, and that the low tariffs have not been brought about through any pressure from outside, but are entirely due to the liberal spirit of the Atlantic companies. Had we chosen to deal with the system as monopolists generally do, we should no doubt have been paying for a time much higher dividends than we pay now, as it must be admitted that the dividends we now pay cannot in any way be characterised as monopoly dividends. The Direct Company has paid under the present management a steady dividend of 5 per cent., and has put by, as I have notified, a very considerable reserve fund. The Anglo Company has not been paying quite so much, and as to the French company they have not yet had an opportunity of showing what they are likely to do. No doubt you will say, What will be the effect of the introduction of the American element into our submarine system? All I can say is this, that judging from the past, and believing in the progress of the future, if the American Company will conduct their cable system in a fair and business-like way, so as to give a moderate return to the shareholders, I believe that such has been the increase of submarine telegraphy that there is room for them as well as for us [hear, hear]. I am not one of those who carp much at the Americans desiring to have cables of their own. The fact is that I am astonished that a wealthy progressive country like America had not submarine cables of their own long ago, but I think it is too much for them to expect that America should now be allowed to control the whole submarine system of the world—the very modest proposal which they made some little time ago. I am hopeful that the pioneers and those who have done so much to promote progress through submarine telegraphy will still retain the place they have so hardly and honourably won [hear, hear, and applause]. Now, gentlemen, I have shown you that, after all, the talk about monopoly in submarine telegraphy is a myth, and that the system has been one in which our policy ought to meet with the commendation of all thoughtful men. But what has been the policy of the land line system of telegraphy in the States—probably the greatest system of land lanes that exists at the present moment—the principal company being the Western Union. In the course of the last twenty-five years that company has absorbed more than sixty telegraph companies, including the Atlantic and Pacific, the Franklin, and the Dominion of Canada companies; and within the last few months they have absorbed the American Union Company, which was established for the purpose of opposing what the promoters called the gigantic monopoly of the Western Union, and with what result? In the process of these sixty absorptions the original capital of 500,000 dols has been increased to 80,000,000 dols, of which a considerable portion I suppose must be "water." I say this, however, upon the authority of a member of Congress. They have not, as far as I am informed, reduced the rates in any way, but have made this enormous increase of capital, no doubt benefiting temporarily the shareholders, but not in the least degree the general telegraphing public. Now, what is this system, this gigantic system, that has been created in America with a capital of 80,000,000 dollars. If I am credibly informed the whole system of lines could at the present time be created for little more than a quarter of that amount. Now this is what I call monopoly. If when the company had been formed they had pursued a policy similar to our own, and gone on reducing the rates, no doubt it would have been beneficial to the public, and no one would have a right to complain; but I cannot believe that the present system will long be maintained. The enterprise of Americans is too well known, the value of money is equally well understood; and I think it is not taking a great liberty with the American people when I say that I believe within a very short period they will have a system at work and tariffs something like 50 per cent. lower than the price now charged by the existing monopoly. I have always taken a deep interest in the progress of telegraphy, and when I see such a creation as the one I have just referred to coming forward to, as I believe, thwart progress, I think it is my duty to draw attention to it [hear, hear, and applause]. I do not wish it to be understood that I am speaking of monopoly in America only. Other nations on the continent of Europe are monopolists, but they have introduced low rates within their own boundaries, and the public of those countries are deriving great benefit; therefore I have not a word to say against them for that, but I should wish them to adopt a broader international policy which would make low through rates current throughout Europe. Before I conclude I have just another remark or two to make. As you are aware these companies had legal contracts with the American land lines. We sent over our secretary and manager to see the authorities there who now control the land system, and who have created the cable project, with the view of bringing about an arrangement The negotiations entirely failed. We found if we had made an arrangement they would have received some amount to enable them to pay on their watered stock, and therefore we were not at all prepared to enter into any such arrangement [hear, hear]. We are now going on the principle of dealing with a shilling rate, conducting our business in a business-like way, giving every possible facility to the public, and I hope that those who do the work the best will get the largest share of public patronage. There can be no doubt whatever that the growth of telegraphy is somewhat beyond what we have any idea of. It is a power extending from day to day. Every man, more or less, in business or out of business, is obliged to avail himself of it; and looking to the growth of population and the expansion of commerce, there can be no doubt that submarine telegraphy must always play a conspicuous part. I hope I shall be able to meet you on many future occasions [hear, hear], if God spares us, to congratulate us all on the steady progress of this Company. With these remarks I beg to propose the following resolution:—"That the report of the directors, dated 19th July, 1881, together with the statement of accounts to the 30th June, 1881, annexed thereto, be, and the same are hereby adopted; and that a final dividend be now declared of 5s. per share, free of income-tax, making, with the interim dividends already paid, a total dividend of 5 per cent. for the year ending 30th June, 1881."

Mr. WILLIAM FORD: I beg to second the motion.

The CHAIRMAN: If any gentleman has any question to ask, I shall be glad to answer him. If not I put the resolution. He accordingly put the resolution, and declared it carried unanimously. Continuing, he moved the re-election as a director of Lord Hawke.

Mr. E. M. UNDERDOWN seconded the motion, and it was carried unanimously.

On the motion of the CHAIRMAN, seconded by Mr. FORD, Admiral the Hon. Sir Henry Keppel, G.C.B., was next re-elected to his seat at the board.

Mr. JACKSON then moved, and Mr. HENRY WEAVER seconded the re-election for the ensuing year of the auditors, Mr. J. G. Griffiths and Mr. Joseph Sawyer. The motion was carried unanimously.

Mr. CHARLES HART: I move that the best thanks of the meeting be given to the Chairman for the kind and courteous way in which he has brought our matters before us to-day. It must be very gratifying to him and to the other Directors to find such a body of satisfied shareholders. On the last occasion there was not a word uttered by them, and that has been the case to-day. I am sure this must be very pleasing to them. There is one remark I should like to make—that notwithstanding the satisfactory statement which has been made to-day the shares in the market still stand at a very low price. I cannot quite understand that, but I suppose that the fear of competition has something to do with it. I should like to ask the Chairman when this new cable is to come into operation, and whether they know anything about the action they will take. While I do that I beg to move that the best thanks of the meeting be given to the Chairman and Directors.

Mr. WEIR: I will second that resolution. I think it will be much better to leave in the hands of the directors the question of the steps they will take as regards the coming competition. I think we are in the right hands—in the hands of gentlemen who tell us that we have a reserve fund of £235,000. They don't ask us either to accept their statement as to that, but they give us a splended list of securities, which is not always done in

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companies. You do not always find a list of securities given, and if you ask for them you are told that you had better change your money into something else. Here we have directors who give us a list showing us where every penny is, and they are all solid investments. I think we should leave future arrangements in the hands of the directors.

The CHAIRMAN: I am very much obliged to you, gentlemen, and thank you on behalf of the directors and myself. As to the remarks which came from the gentleman who last spoke with regard to the securities, I think it is a very good thing to show our shareholders where our reserve fund lies. We could turn it into account to-morrow if we chose, and have it in money. I am equally glad to say that so far our investments have been fortunate, and I believe that they are worth £13,000 more than they stand at in the balance sheet. The interest that accrues from these securities we add to the reserve fund. As to the general management all I can say is this—it is our ambition to protect the interests of the shareholders and at the same time to maintain our system in such a way as we, who take an active part in it, feel proud of, and also in such a way—I say it without any egotism—as to do credit to England, for having taken such an important part in the spread of this great element of human progress. I believe at the present moment that there is not a country in the world where there is any trade or commerce worth speaking of that is not now connected with submarine telegraphy. I think that the whole system of telegraphy ought to be as much as possible international, and that every nation that claims to take any part in the progress of the world should help, aid, and assist this great and grand system. I beg to thank you, gentlemen [applause].

The proceedings then terminated.

ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED.

Report of the directors to the ordinary general half-yearly meeting, to be held at the City Terminus Hotel, Cannon-street, E.C., on Friday, August 5th, 1881. The total receipts from the 1st January to the 30th June, 1881, including a balance of £66 6s. 10d. brought over from the last account, amount to £300,431 18s. 10d. The traffic receipts show an increase as compared with the corresponding period of last year of £31,455. The total expenses of the half year, including income-tax and repair of cables, &c., as shown by the revenue account, amount to £61.885 19s. 6d. The directors, under the powers conferred upon them by the Articles of Association, have, before declaring the net profits, set apart the sum of £75,000 to the renewal fund, leaving an available balance of £163,545 19s. 4d. One quarterly interim dividend of 2 per cent. on the Preferred Stock, and of 1 per cent. on the Ordinary Stock, free of income-tax, was paid on the 1st May, 1881, absorbing £70,000, and a second quarterly interim dividend at the same rates, free of income-tax will be paid on the 2nd August, 1881, leaving a balance of £23.545 19s. 4d. to be carried forward to the next account. As already announced in the Circular dated the 23rd February last, the action "Thorne versus the Anglo-American Telegraph Company" was dismissed by consent of the trustee in the plaintiff's bankruptcy, and the suspended dividend was paid forthwith. The Brest St. Pierre Cable, laid in 1869, which was broken on the 12th November last, has been picked up in 1,700 fathoms of water, and repaired by the Telegraph Construction and Maintenance Company with their ss. "Scotia." The repairs were completed on the 6th inst. The Company has now four Atlantic cables at work, and their system throughout is in good working order and condition. The Company's repairing ship "Minia" has been engaged during the half year in repairing the Placentia-St. Pierre cable laid in 1872, the North and South Placentia cables laid in 1873, and in the repair and diversion off Seal Island of the St. Pierre-Duxbury cable laid in 1869. She has also been engaged in the repair of the Direct U.S. Cable Company's cable between Torbay and Ryebeach, having been chartered to that company for the purpose. Since the last general meeting of the proprietors in February a very important combination of the land telegraph companies in the United States of America has taken place. The Western Union Telegraph Company (with which this Company has an agreement, made in 1870, for the exclusive interchange of Atlantic cable traffic, and for the use of land lines between New York and the termini of the cables) has amalgamated with its former competitors (The Atlantic and Pacific Telegraph Company and The American Union Telegraph Company), and has leased the lines of The Dominion Telegraph Company of Canada, thus greatly extending and strengthening its position. It also took over and engaged to carry out a contract by which the American Union Company was bound to give all its cable traffic to two new cables then about to be laid (and one of which has now been completed) by Mr. Jay Gould and his associates, who were formerly directors of the American Union Company, but are now directors of the Consolidated Western Union Company. In view of the complications thus created, the solicitor of the Company was requested to go to New York, in February last, in order to ascertain the exact position of affairs and to take any steps which might be necessary for protection of this Company's interests. Legal proceedings had previously been commenced by several parties, to endeavour to prevent the great combination then in progress, and to prohibit the carrying out of the contract, referred to in paragraph 9, with Mr. Gould's Cable Company; but as the Anglo Company's rights had not been infringed, the directors did not consider it necessary to enter upon litigation, as they were advised that the agreement of 1870 was in full force, and could be at all times maintained in the Courts of Justice. Under pressure of an action by the Paris and New York Telegraph Company, the contract with Mr. Gould's Cable Company has now been cancelled. Proposals were made in conjunction with the representatives of the Direct United States Cable Company and the Paris and New York Company for a traffic arrangement with the new Cable Company: but as no terms could be agreed upon which the directors could recommend the proprietors to accept, they broke off the negotiations. The directors have decided, with the approval of the Direct United States Cable Company and the Paris and New York Company to reduce the tariff for messages between the United Kingdom, France, and New York and Canada to one shilling per word from the 1st August, 1881. The directors hope that the adoption of this low rate will result in a large increase in the number of messages, and render unnecessary any further arrangements with rival companies.

ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians,
86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.
Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

COOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

ESTABLISHED 1851.
BIRKBECK BANK.—Southampton Buildings, Chancery Lane.
Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.
HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.
HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
Southampton-buildings, Chancery-lane

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

NORTHERN FIRE and LIFE ASSURANCE COMPANY.
Established 1836.
Head offices—Aberdeen and London.

Subscribed Capital	£3,000,000
Of which paid up	300,000
Fire Reserve Funds	637,977
Life Funds, as per last account	£1,462,146

A. P. FLETCHER, General Manager.

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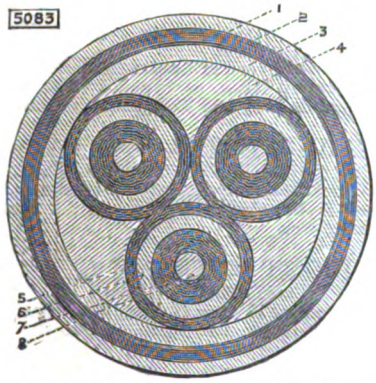
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

5083. Improvements in the Manufacture of Cables for Telegraph and Telephonic Purposes, and in Apparatus employed therein, *E. Berthoud and F. Borel.*—6*th December*, 1880. 6*d*.

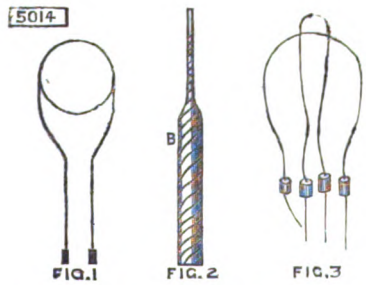
The First part of the invention relates to the cables themselves, as described in a former patent, No. 4346, 29th October. 1878. The cables are so constructed that all induction between the several conductors is obviated. The materials and their arrangement are shown in the figure. The outer



ring 1 is a leaden sheathing, 2 is gas tar; 3, leaden sheathing; 4, insulating material. Of the inner cables, the outer ring 5 is composed of cotton impregnated with insulating material, 6 is a leaden strip; 7, cotton same as 5; and 8 is the copper wire conductor. The second portion of the invention refers to the machinery and method of making these cables.

5014.—Electric Lamps, *J. W. Swan.*—2*nd December*, 1880. 6*d*.

This specification relates more particularly to improvements in the method of preparing the carbons for the inventor's incandescent lamps, as described in his patent No. 4933, 27th November, 1880. The inventor's object is to thicken the ends of the carbons, so as to facilitate the connection between them and the metallic conductors, and to prevent heat at the points of contact. This is obtained as follows:—The inventor wraps the ends of the converted cotton



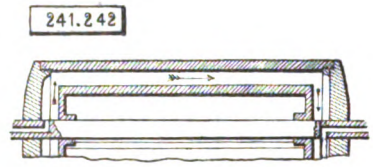
thread—patent No. 4933—Figs. 1 and 2, with strips of bibulous paper. The thread thus thickened, as shown at B, is subjected to the action of sulphuric acid, as described in the former patent mentioned above, and having been washed and dried is compressed into shape as shown in Fig. 1. It is then carbonised. Various other methods are also described. Fig. 3 shows a lamp arranged with multiple carbons, so that one or more may be rendered incandescent at the same time, a system which permits of variation in the intensity of the light. The carbon is sometimes also flattened, thus obtaining a greater radiating surface and more light.

5141. Magnetic Apparatus for Separating Iron Particles from Wheat, Flour, &c., *T. M. Clarke.*—9*th December*, 1880.—(*Not proceeded with.*) 2*d*.

The magnets are caused to rotate and come in contact with scrapers on the opposite side to that over which the wheat passes, so as to remove the particles of iron from off the magnets.

241,242. Armature for Dynamo-Electric Machines, *William E. Sawyer, New York, and Edward R. Knowles, Brooklyn, N.Y., assignors to Eastern Electric Manufacturing Company, Middletown, Conn.*—*Filed Jan.* 12*th*, 1881.

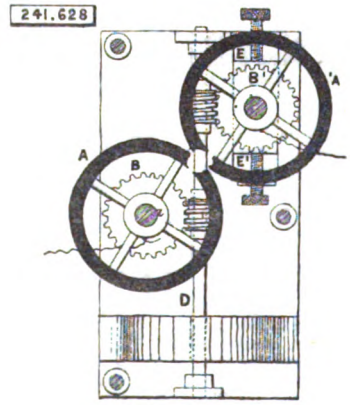
Brief.—The armature is composed of two concentric cylinders, the space between the cylinders forming a passage for water, whereby the armature is kept cool. *Claim.*—(1) A dynamo-electric machine, the armature of which consists of two cylinders suitably secured to the armature-shaft in such manner as to leave an annular water



space between the cylinders larger than the opening through which the water flows into and out of said water space, substantially as described, and for the purpose set forth. (2) A dynamo-electric mrchine, the armature of which consists of an outer and inner cylinder suitably secured to the armature-shaft, whereby an annular water space, as described, is provided between the outer and inner cylinder, substantially as set forth.

241,628. Electric Lamp, *David W. De Forest, Brooklyn, assignor to William Buchanan, New York, N.Y.*—*Filed December* 6*th*, 1880.

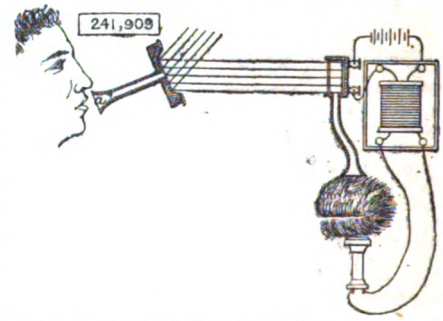
Brief.—Two carbon discs or annular carbons mounted on shafts, one of which is made adjustable toward or from the other, are rotated by clockwork acting through a screw and gear wheel. *Claim.*—(1) The circular carbons A and A^1, the shafts A and A^1, and the gear wheels B and B^1,



in combination with the worm wheels C and C^1, the shaft D, and a mechanism for slowly rotating the shaft D, substantially as and for the purpose described. (2) The circular carbon A^1, shaft A^1, and adjustable bearings E and E^1, in combination with the circular carbon A, shaft A, provided with stationary bearings and mechanism for rotating the same, substantially as and for the purpose described.

241,909. Photophonic Receiver, *Alexander G. Bell and Sumner Tainter, Washington, D.C.*—*Filed March* 24*th*, 1881.

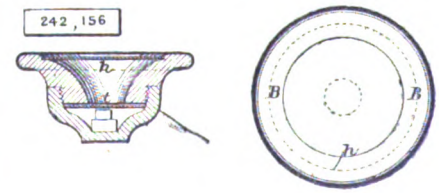
Claim.—(1) In a photophonic receiver, the sound chamber for containing the sensitive medium, having a wall transparent to light or radiant energy, but opaque or less transparent to sound, substantially as described. (2) The combination of the sound chamber having a wall transparent to radiant energy, but opaque or less transparent to sound, with the sensitive medium therein contained, and a sound conveyor or opening communicating with the interior of said chamber, substantially as described. (3) In a photophonic receiver, the sensitive medium, composed of vibratory material in an open, porous, or subdivided condition, substantially as described. (4) In a photophonic receiver, a sensitive medium of lampblack or similar material, substantially as described. (5) A photophonic receiver having as the sensitive medium a deposit of vibratory material in a loose, porous, subdivided, flocculent, or spongy condition, substantially as described. (6) In a photophonic receiver, the combination of a sensitive medium conductive of electricity, in a loose, porous, or subdivided condition, such as lamp-black, and conductors for including the same in an electric circuit, substantially as described, so that radial vibrations can be thereby converted into electric vibrations, as set forth. (7) The combination of the lamp black or other vibratory conducting material in loose particles, the rigid or substantially inextenstible support of insulating material, and conductors by which the lamp-black can be included in an electric circuit, as set forth. (8) A cell comprising sheets, plates, or strips of conducting material, fixed or mounted upon a support of insulating material, with their edges opposite each other and separated by a suitable distance, and sensitive conducting material in the space or spaces between said edges, substantially as described. (9) A support of insulating material, having comb-shaped conductors fixed or mounted on said support, as indicated, so that the teeth of the combs intermesh but are not in contact with each other, substantially as described. (10) A silvered plate having the silver film mechanically ruled or scraped, as



described, so as to leave parallel lines or stripes of equal width, and with sharp, clean edges, substantially as set forth. (11) The insulating plate having on one or both sides a silver film ruled or scraped, as described, so as to divide the silver film into two or more conductors, in combination with binding posts connected with the parts of said film or films, substantially as set forth. (12) The combination of the insulating plate and ruled silver film with the lamp-black or sensitive medium included in the ruled or scraped spaces in said film, substantially as set forth. (13) The combination, with a galvanic circuit, of a photophonic cell, comprising a glass plate with ruled silver film thereon, lamp-black deposited in the ruled spaces in said film, and connections for completing the galvanic circuit through said cell, substantially as described. (14) The combination, with a photophonic cell, of an induction coil, electric connections for including said cell in one circuit of said coil, and a telephone circuit connected with the other circuit of said coil, substantially as described. (14) A photophonic receiver comprising a sound chamber having a wall transparent to radiant energy, but opaque or less transparent to sound, a cell having a vibratory sensitive medium, such as lamp-black, electrical connections for connecting said cell in an electrical circuit, and a hearing tube connected with the interior of said sound chamber, substantially as described.

242,156. Telephone, *Chas. W. Raymond, New York, N.Y.*—*Filed January* 29*th*, 1881.

Claim.—(1) A telephone in which a supplemental diaphragm covers the mouthpiece, substantially as set forth. (2) The combination, in a



telephone, of the usual diaphragm at the bottom of the mouthpiece, a diaphragm covering and extending over the mouthpiece, and a disc H beneath the outer diaphragm, substantially as described.

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239,373. Electric Lamp, *Thomas A. Edison, Menlo Park, N.J.—Filed August 17th*, 1880.

Claim.—The combination, with the neck of the inclosing globe and the carbon supporting tube, of a cup containing a liquid receiving the end of the neck of the inclosing globe, and through which passes the carbon supporting tube, and washers or plugs filling the space between the neck and cup and the neck and tube, substantially as set forth.

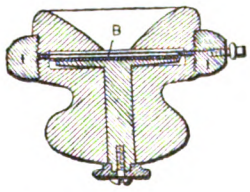
239,766. Mechanism for Laying Telegraph Wires, *Edwin T. Greenfield, Brooklyn, N.Y., assignor of one-half to the Holmes Burglar Alarm Telegraph Company.—Filed January 8th*, 1880.

Brief.—To carry a wire over buildings, &c., a carrier propelled by spring and clockwork, and, travelling on an adjacent wire, carries the end thereof or a cord secured thereto. *Claim.*—(1) The hereinbefore described method of laying or stringing telegraphic or similar wires, which consists in carrying the end of the wire from one point of attachment to another by means of a carrier moving automatically along another wire, which follows the general direction between such points, substantially as set forth. (2) In a carrier constructed to move along a wire, a grooved wheel, in combination with a friction roller and driving mechanism, substantially as and for the purpose described. (3) In a carrier constructed to move along a wire, a main or driving spring, in combination with a grooved wheel and a friction roller, substantially as and for the purpose set forth.

240,578. Mode of Transmitting Sound by Electricity, *Amos E. Dolbear, Somerville, Mass.—Filed February 24th*, 1881.

Claim.—In combination, a primary coil in circuit with battery B and transmitter T, and a secondary coil with its enlarged terminal mounted

240.578

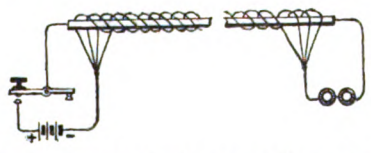


in a case, and arranged near a plate, the plate being also mounted in a case, but not connected with the secondary coil, all substantially as described.

240,599. Telegraph Circuit, *Orazio Lugo, New York, N.Y.—Filed February 19th*, 1881.

Claim.—The electric telegraphic or telephonic

240.599

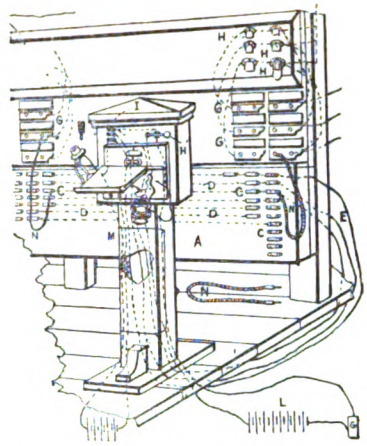


conductor herein set forth, constituting a solenoid.

240,983. Telephone Central Office Apparatus, *T. Gardner Ellsworth, New York, N.Y.—Filed April* 1880.

Brief.—The switching apparatus consists of a number of horizontal rows of metallic plates, all the plates in each row being connected by a wire at the back of the switch board, and each row being connected with an operating stand having the necessary apparatus for signalling and receiving orders. The subscribers' lines pass to ground through anunciators, and may be connected by flexible conductors and plugs to the above-mentioned plates, connection being made by plugging to the same horizontal row. *Claim.*—(1) In a telephone central office system, the combination, with the isolated stand M and the telephonic instruments, switches I, and call key H^1, placed thereon, of the anunciators H and switches G, connected as shown, the switch board A, having plates C, connected by wires D and provided with holes or sockets, the flexible switch cord N, having terminal plugs, and the wires E, which connect said switch board and the stand switches I, all

240.983

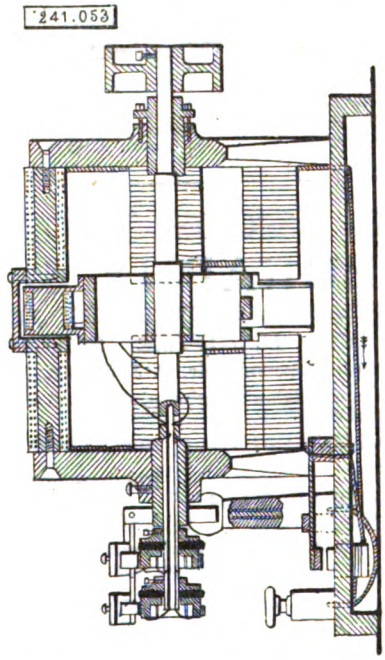


as shown and described. (2) In a telephone system and apparatus, the hollow telephone stand M, constructed substantially as herein shown and described.

241,053. Dynamo-Electric Machine, *Hans J. Muller, New York, N.Y., assignor to himself and Alexander Levett, same place.—Filed November 9th*, 1880.

Brief.—A relay and resistance are combined with the secondary circuit to direct the secondary current through the field magnets in the same direction as the primary current. The arms of the armature wheel are broad in the direction of the axis, to serve as fans for cooling the bobbins. *Claim.*—(1) In a dynamo-electric machine, the combination of the negative wire with a relay and

241.053

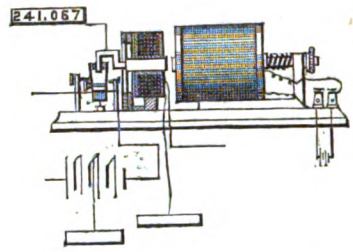


a resistance, substantially as shown and described, for the purpose of conducting the secondary current through the field magnets in the same direction as in the main current and to regulate the permanent charge of the machine. (2) In a dynamo-electric machine, the rotating armature wheel, having open sides and a series of broad spokes arranged radially and severally parallel to its axis, and the broad periphery, having openings between each two spokes and between each two coils, all as shown and described, to operate as and for the purpose specified.

241,067. Telegraphic Relay and Repeater, *Charles A. Randall, New York, N.Y., assignor to Philip G. Randall, same place.—Filed March 11th*, 1881.

Claim.—The combination with a confined elastic armature arranged for operation by an electro-magnet, of a metallic contact point carried by said armature, and two other contact points either or both electrical, arranged to be operated

241.067

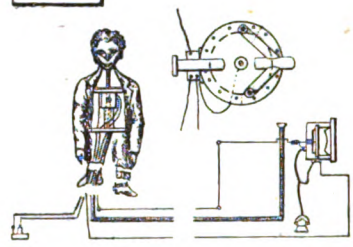


by the action of the armature, and arranged to yield together, but to preserve a fixed distance from each other, substantially as described.

241,346. Telephone, *Gay W. Foster, Chicago, Ill.—Filed June 14th*, 1880.

Claim.—(1) The combination of an image representing a man or other object, with a speaking-tube and electric telephonic transmitter, substan-

241.346

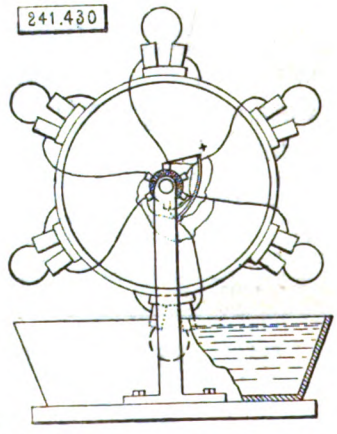


tially as and for the purpose described. (2) The combination of an image representing a man or other object, with a speaking-tube, electric telephonic transmitter, and connected pair of acoustic diaphragms, substantially as and for the purpose described.

241,430. Electric Lamps, *William E. Sawyer and Robert Street, New York, N.Y., assignors to Eastern Electric Manufacturing Company, Middletown, Conn.—Filed December 2nd*, 1880.

Claim.—(1) An incandescent electric lamp provided with two or more carbons, in combination with a bath of hydro-carbon and connections as described, with a source of electric energy, whereby one carbon may be heated and renewed in the bath while the other is being burned. (2) In an incandescent electric lamp, one or more carbon conductors and connections with a source of electric energy, in combination with an open bath

241.430



of liquid hydro-carbon, whereby said carbon or carbons may be burned in open air and renewed when desired without removal from the lamp, substantially as set forth. (3) In an electric lamp, the combination of a wheel or disc, provided with a series of carbons, and connections with a source of electric energy, as described, said wheel or disc being adapted to be rotated, whereby pairs of opposing carbons may be brought into the electric circuit as described, and one carbon renewed in the hydro-carbon while the other is being burned, substantially as set forth.

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SLIP

West Indies.—Telegraphic communication with all places in the West Indies is now restored.

Direct United States Cable Company.—The estimated cable receipts for July, 1881, amounted to £15,470, and those for July, 1880, to £6,500.

Electric Light for Belfast Harbour.—The contract for lighting this harbour by electricity has been taken by Messrs. Crompton and Co.

The Telephone in America.—It is stated that in many of the largest towns in the United States the ratio of telephones to inhabitants is 1 to 125.

Telegraph Extensions in Tasmania.—The *Colonies and India* says "that the line of telegraph from Launceston to Beaconsfield has been completed."

Electric Light at Cape Town.—It is stated that arrangements are in progress for illuminating the railway station in Cape Town with electric light.

Direct Spanish Telegraph Company.—The traffic receipts for the month of July, 1881, amounted to £1,448, as against £1,423 in the corresponding period of last year.

Anglo-American Telgraph Company.—The traffic receipts of this company for the month of July last were £46,410, against £19,500 in the corresponding month of 1880.

Tunis.—Information from Tunis up to 30th ult. reports that telegraphic communication with Susa has been interrupted for some few days, and many telegraph posts have been burnt.

Correction.—By an oversight we omitted to state that the article relating to the "Expansion Voltameter," by G. M. Hopkins, which we printed in our issue of the 23rd ult., appeared originally in the *Scientific American*.

New Cable on the Canadian Coast.—It is stated that a cable is to be laid from Cape Ray to Big Lorraine, C.B., for purposes of meteorological observation, and that the contract for its construction has already been taken.

Queensland Telegraph Extensions.—News from this colony says that the telegraph surveyor and his party had arrived at Thargomindah from Eulo. The proposed new route is thirty miles shorter than the present line.

Honours for Bravery.—Mr. Houston, who displayed great bravery on the occasion of the torpedo explosion on board the "Cerberus," has, we hear, been rewarded by being promoted to a higher post in the telegraph service.

Honours for an Electrician.—*La Lumière Electrique* says that M. Charles Bourseul, who was the first to show the way in which speech might be reproduced by telegraph, in 1854, has been nominated *chevalier* of the *Legion d'Honneur*.

Electric Lighting in Glasgow.—At the last meeting of the Town Council of Glasgow notice of motion of the desirability of considering the question of lighting some of the principal thoroughfares with a few of the best electric lights was given.

Electric Light at Naples.—The railway station at Naples has been for some time past illuminated by five electric lamps, said to be each equal to 50 gaslights. The lamps are worked by Gramme machines, and are said to have given satisfaction.

Western and Brazilian Telegraph Company.—The traffic receipts of this Company for the week ending the 29th of July amounted to £1,877, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company.

The Telephone and "The Times."—*The Times* has the speeches of the members of the House of Commons transmitted verbally by the United Telephone Company's line to Printing House-square, this system being the means of great saving of labour and expense.

Electric Light in Canada.—The Ottawa Gas Company, unlike their less fortunate brethren the Dublin Gas Company, have obtained the authority of the Corporation to introduce the electric light into Ottawa. We wish them success in their undertaking.

The Brockie Light at the Post Office.—Some improvements have been introduced into this system of lighting, and although it has not proved satisfactory for the purposes of the Telegraph Department, it has been extended to the Inland Letter Branch with great success.

Street Lighting.—Under the stimulus of the electric light eastwards, the West End is extending the system of improved gas lighting. Forty-three lamps of Bray's pattern have just been erected in Piccadilly, and others are to be erected in the neighbourhood of Charing-cross.

The Paris Electrical Exhibition.—Quite unexpectedly, on Saturday last intelligence was received, and printed in our Special Edition of that date, that the opening of the International Exhibition of Electricity, which was fixed for the 1st inst., had been postponed until the 11th.

Telegraphic Instruction in France.—It is stated that a camp is to be formed just outside Vincennes, near Paris, on the Plateau de Gravelle, having for its object telegraphic instruction. It will be connected with the Gravelle Redoubt, which latter will be used as a depôt for material.

Great Northern Telegraph Company.—The traffic receipts of this company for the month of July last amounted to £22,400; and for the period from the 1st of January to the 1st of July, 1881, they were £136,240, against £131,313 for the same period of 1880, and £116,623 in 1879.

Overhead Wires.—The St. George's (Hanover-square) Vestry Committee of Works at their last meeting considered the question of overhead wires and the responsibility of local authorities for accidents occasioned by the fracture of such wires. It was decided to appoint a sub-committee to go into the question.

Thunderstorm. — A severe thunderstorm broke over Sheffield last week. Whilst the storm was at its height a gunner named Thompson, who was in the barracks, was struck by lightning, and remained unconscious for two hours. A public-house in the same neighbourhood was struck, and considerable damage done.

Consolidated Telephone Construction and Maintenance Company.—Notice is given that the statutory general meeting of this Company will be held at the Cannon-street Hotel, Cannon-street, London, E.C., on Monday, the 8th August, 1881, at three o'clock, to transact the ordinary business of the Company.

Prices.—The prices as quoted are, for gutta percha, per lb.:—Genuine, 4d. to 3s. 3d.; re-boiled, 3d. to 1s. 3d.; for India rubber, fine Para, 3s. 6½d.; negrohead, 2s. 2½d.; central American, 1s. 9d. to 2s. 3½d.; Assam and Pegu, 1s. 3d. to 2s.; other east Indian, 1s. 4d. to 2s.; Madagascar and Mozambique, 1s. 6d. to 2s. 3d.

Cuba Submarine Telegraph Company.—The number of messages passing over the lines of this Company during the month of July last was 2,492, estimated to produce £2,300,

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against 2,458 messages, producing £2,915 in the corresponding month of last year. The traffic receipts for the month of May last, estimated at £3,000, realised £3,021.

THE BRUSSELS OBSERVATORY AND THE EXHIBITION.—During the time that the Electrical Exhibition remains open the Palais des Champs Elysées, where it is to be held, will be connected with the Observatory at Brussels, and the telemeteorograph of M. Van Rysselberghe will register in Paris the meteorological observations made in Brussels.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.—The first distribution in respect of the capital of the certificates of this Company, issued under the trust deed of the 12th of March, 1875, will be made on and after the 10th instant. It will be at the rate of £2 10s. per £5 certificate, and will be paid by Messrs. Barclay, Bevan, and Co.

THE NEW SCHEME OF PAY FOR TELEGRAPHISTS.—We understand that the revised scales of pay lately sanctioned by the Treasury have been applied to the clerks in the metropolitan districts. At the central station, however, this is not yet the case, although a considerable number of the junior body have received promotion under the old scheme.

A CABLE TO THE MAURITIUS.—At a recent meeting of the Academy of Sciences of Paris M. Faye read a memoir by M. Bridet, addressed to the Minister of Marine, and forwarded to the Academy by the latter, "On the Laying of a Cable from Reunion to Mauritius by the French Government." We have commented on this project in our leading columns.

MONTREAL TELEGRAPH COMPANY.—This company was organised in 1847 with a capital of £15,000. It had 500 miles of poles and wires and 9 offices. It has now a capital of £500,000, 12,700 miles of poles, 21,500 miles of wire, and 1,647 offices. The number of telegrams sent over the line in 1880 was over 2,000,000, and its earnings for the year were £137,000.—*Journal of the Telegraph*, New York.

ELECTRIC LIGHT AND IRONWORKS.—Messrs. Bolling and Lowe, in their report on the iron trade, say:—"Electric lighting of our large works is gaining ground rapidly, and, unimportant as this may look at first glance, it yet adds to their productive power, for by means thereof many operations may now be carried on irrespective of day and night, all of which enable an increased production to take place."

THE ELECTRIC LIGHT ON BOARD SHIP.—The Cunard Company are fitting their steamship "Servia" with 98 electric lamps on Swan's principle. The lamps are to be disposed in the following manner:—Engine room, 20; propeller shaft tunnels, 10; grand saloon, 50; music room, 8; ladies' boudoir, 6; smoking room, 4. The requisite current will be obtained from a Brush dynamo electric machine, which will be driven by a special engine.

WEST COAST OF AMERICA TELEGRAPH COMPANY.—The report of this Company for the year ending December 31 last, states that the gross revenue was £17,398 4s. 2d., and the expenditure £31,815 1s. 6d., leaving a balance of £14,416 17s. 4d. to the debit of revenue. Since the 1st May this year the receipts have shown a steady increase and all the Company's cables are now in active operation. The claim against the Chilian Government is not yet settled.

THE FITZ-GERALD INCANDESCENT LAMP.—In accordance with invitations issued, a few gentlemen, interested in Electric Lighting, attended on Thursday, the 28th inst., at 80, Gray's Inn-road, Holborn, to witness in operation the Incandescent Light constructed on the system of Mr. Desmond G. Fitz-Gerald. From the simplicity of the principle and facility with which these lamps are manufactured, we are led to believe they will compete most satisfactorily with any hitherto in the field.

TELEGRAPH STORES WANTED.—The Caledonian Railway Company are inviting tenders for the supply of india rubber, iron wire and strand galvanised, telegraph instruments, &c. Specification and forms of tender may be obtained from Mr. William Haig, superintendent of stores, Caledonian Railway, St. Rollox, Glasgow, where also patterns may be inspected between 9 a.m. and 5 p.m. Tenders to the secretary, at 302, Buchanan-street, Glasgow, by the 15th of August.

THE AMERICAN BELL TELEPHONE COMPANY.—The report of this company at the last meeting of the shareholders states that last year the company had 138 telephonic circuits, and 60,873 instruments at work. This year it has 408 circuits open, or about to be opened, with 132,692 instruments. There are in the United States but nine towns with more than 10,000, and only one with more than 15,000 inhabitants, which do not use the telephone.—*Boston Advertiser.*

ELECTRIC LIGHT IN IRON WORKS.—On the 6th ult. seven Brush lamps were erected at the Mostyn Coal and Iron Works. One lamp was used for lighting up the Quay, and this light in conjunction with another fixed with a parabolic reflector apparatus was used as a harbour light for guiding ships up the creek. The lights gave great satisfaction. They were erected by Messrs. Hammond and Company, who are the concessionaires of the Brush system for a large portion of the north of England.

INTERNATIONAL MEDICAL CONGRESS.—For the convenience of the members of the International Medical Congress, now being held in Burlington House, the United Telephone Company have fitted up a private line from the College of Physicians, in Pall-mall, to Burlington House, in Piccadilly, so that conversation between these two buildings may be carried on at will. The company have also made arrangements by which members of the Congress may converse by telephone with any subscriber to their exchange.

LIGHTNING AND HAILSTORMS.—Mr. T. A. B. Oliver, of the Athenæum, Glasgow, writes to the *Colonies and India* that he is preparing a memoir for the Meteorological Society on "Hailstorms," and asks for particulars from those who may have opportunities of observing such storms. Amongst the data which he asks for, the following occurs under the head of "Electrical Phenomena:"—Should there be lightning, note the relation between the discharges and the fall of the hail—whether the lightning precede the hail, or *vice versâ*.

THE UNITED TELEPHONE COMPANY.—The first annual meeting of this company will be held at the Cannon-street Hotel, on August 9th, at 2 p.m., to receive the report of the directors for the year ending the 30th of April. The business of the meeting will also include the sanctioning of an agreement with Mr. C. H. Reed, of Sunderland, iron manufacturer, for granting to a company, intended to be formed under the name of "The Northern District Telephone Company (Limited)," exclusive licenses for the use of the company's patents in certain districts.

ELECTRICITY AND OUR NAVY.—It is stated that revised instructions have been issued by the Admiralty for the planning and fitting of electric and torpedo gear in ships of the navy. The position, arrangement, and fitting of all machines for the generation of electricity, circuit lights, torpedo gear, and wire leads, pumping and charging columns, for either ship or boat are to be planned with the concurrence of the Captain of the Vernon School Torpedo Ship at Portsmouth. When completed, and if possible before a ship is passed into

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the first division of the Steam Reserve, the Captain of the Naval Torpedo School is under directions from the Admiral Superintendent to cause the whole of the fittings to be tested and inspected.

THE ELECTRIC LIGHT IN LAMBETH.—At the last meeting of the Lambeth Vestry, the Lighting Committee reported an interview they had with the manager of the Anglo-American Brush Electric Light Corporation to obtain some information relative to lighting a part of the parish, and since then a letter had been received from the company to the effect that they contemplate making arrangements to establish an electric lighting station, on a somewhat large scale, and asking that the matter might stand over until they could decide definitely as to the lighting station.

ELECTRIC LIGHTING AT CARDIFF.—There is quite a display of the different systems of electric lighting at Cardiff just now, at the Fine Arts and Industrial Exhibition now being held. There are seventeen Brush lights, lent by Messrs. Hammond and Company, of London, which light up a portion of the exhibition, also the outside and part of a street adjoining. The British Electric Light Company have six of their lamps on show also. Messrs. Siemens exhibit six of their lights, and some of Swan's incandescent lamps are shown in a grotto with water falling, giving a very pretty effect.

TREAT TO TELEGRAPH BOYS.—The Dowager Duchess of Manchester and Mr. Stevenson Blackwood invited 250 telegraph boys, and a band from Dr. Barnado's home, to spend the Bank Holiday in their grounds at Shortlands, Bromley, Kent. Several of the principals of departments were present, also Lord Kinnaird, and the City missionaries to the London postmen and telegraph boys. A dinner was provided, and the afternoon was spent in amusements and athletic sports. Before separating in the evening the duchess presented prizes for good conduct and skill in athletic sports.

OBSERVANCE OF SUNDAY AT THE EXHIBITION.—Our French contemporaries are very much exercised at the suggestion of the Lord's Day Observance Society, which we alluded to in a recent note, that English exhibitors should not require the services of their attendants on that day. One of them remarks, "Without speaking of the religious side of the question—in a country where liberty of conscience is an absolute principal—it is greatly to be regretted that, owing to an exaggerated and ridiculous puritanism, the Exhibition will be deprived each Sunday—the only day on which the workaday world can visit it—of an important part of its attractions." We hear that the United States exhibitors will unite with the English in the observance of the Sunday.

ACCIDENT BY LIGHTNING.—At Portslade, near Brighton, recently, a man named Christopher Thomas Mitchell, a carpenter, was killed by lightning under the following circumstances:—The deceased was caught in a violent thunderstorm as he was returning home from his work, and as he was passing near Aldrington Church a man, who had taken shelter in a doorway, saw him struck down by a flash of forked lightning, and on going to him found him on his face quite dead. The medical evidence showed that the deceased was struck by the electric fluid at the back of the neck, and that it afterwards passed down the left side, across the lower part of the body, and down the right leg. The right leg of the deceased's trousers was torn the whole length, and the heel of the right boot was forced outwards.

PROPOSED TELEPHONE EXCHANGE FOR THE POTTERIES.—A meeting of the Council of the Chamber of Commerce was held at Hanley recently for the purpose of considering a proposal of the Post Office authorities to establish a telephone exchange for the Potteries district. Mr. Snell, from the General Post Office, attended to explain the proposal. The proposal embodied a scale of charges per mile. A long discussion took place, in which it was urged that the rate should be uniform, and it was considered that without some alteration in the scale of charges proposed it would be impracticable to adopt the scheme in this scattered district. Mr. Snell intimated that he could hold out no hope of any modification of the terms, and consequently the meeting reluctantly but unanimously decided that the proposal of the Post Office authorities could not be carried out.

NEW AMERICAN COMPANY.—The *Standard* New York correspondent reports that:—A Postal Telegraph Company which promises to be a formidable rival of the Western Union has been organised. Mr. James R. Keene is the president Among the stockholders are the Californian Bonanza millionaires. The Company have acquired several novel patents, including W. A. Leggo's automatic machines, said to send two thousand words a minute; the Leggo fac-simile machine, which sends autographic telegrams (those shown are like photographs); the Gray harmonic multiple system, which is claimed to surpass even the quadruplex. The Way duplex system has also been acquired. Peculiar interest attaches to this invention, owing to its alleged applicability to cables. Relays are not used even on land. The capital of the Company is twenty-one million dollars. The subscriptions announced amount to ten millions. They have already spent on plant and patents over two millions. It is estimated that the total cost and equipment sufficient for any amount of business will not exceed fifteen millions.

THE CONDENSER SUPERSEDED.—M. Rupalley, of 31, Rue Jeanne D'Arc, Rouen, writes to our contemporary, *L'Electricité*, as follows:—"I was present a few days since at an interesting experiment which was carried out at the Lycée at Rouen, in connection with the singing condenser. The experiment was the result of chance investigation by one of the young men employed in the physical laboratory at the Lycée. You know that in the ordinary experiment the speaker into which one sings is placed in the induction circuit, and the ends of the wires of the induction coil are connected with the terminals of the condenser. In the experiment which I saw, the condenser was not used, though the induction circuit remained unchanged, the ends of the wire of a moderately strong coil being simply brought into close proximity, at a distance of about three millimetres. Each time the speaker vibrated, a spark passed between the two wires, and at the same time it sang so clearly as to perfectly reproduce the song which was sung into the transmitter, and almost as loudly as when the condenser was employed. What should we obtain if we caused the spark to pass in a gas, other than atmospheric air, say, for instance, carbonic acid? Would a Geissler tube filled with carbonic acid at a feeble pressure sing?"

THE INDUCTION BALANCE AND SURGERY.—A telegram to the *Standard*, dated New York, Monday night, says:—"At Washington, at yesterday evening's dressing of Garfield's wound, the ball was 'located' by Professor Bell's induction balance, which gives audible warning when the proximity of metal disturbs the equilibrium of the electric currents. The apparatus indicated that the ball lies in front of the wall of the abdomen, five inches below and to the right of the navel, just over the groin. To-day's experiments with the induction balance are confirmatory of those of yesterday. The physicians believe that the information is sufficiently definite to justify their proceeding upon it when advisable. The

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depth of the ball is less than two inches, and it is easily and safely accessible. The process pursued is entirely painless; the instrument did not even touch the flesh. The President manifested much interest in the result. Much medical and scientific interest is felt in the experiment, apart from its bearing on the President's case, as it appears quite possible that the probe will be superseded by the induction balance." Perhaps Professor Bell lent the induction balance used on this occasion, but we think the correspondent of the *Standard* is in error in calling it "Professor Bell's induction balance," seeing that the apparatus in question is the invention of Professor Hughes, F.R.S., of London.

THE METROPOLITAN BOARD OF WORKS.—At the last meeting of this board, the following remarks referring to the Electrical Exhibition and Congress at Paris, are instructive, as showing the usual state of placid ignorance concerning matters in general, and this matter in particular, which prevails among the members of our Government offices. Our extract is taken from the report of a contemporary, the *Metropolitan*, and runs as follows:—"Mr. Dalton moved the adoption of another report that was presented by the Works and General Purposes Committee, stating that the committee do not consider it desirable that the Board should be represented at the Electrical Congress about to be held in Paris. Mr. Fowler said there was not to be any Electrical Congress at Paris at all, but an exhibition of electrical appliances. The report had, therefore, been agreed to under a misconception, and he would move as an amendment that it should be referred back to the committee, for them to consider as to whether it would be desirable to request the consulting chemist to report upon the many valuable improved modes of producing and using the electric light that were sure to be exhibited there. The amendment, however, was not seconded, and the motion was agreed to." If there is to be no congress, why should members have been appointed to represent Europe and America at a congress of electricians to be held in Paris in connection with the Exhibition?

TELEGRAPHIC INTERCOURSE BETWEEN GIBRALTAR AND FRANCE.—The following agreement between the United Kingdom and Spain and France, having as its object the facilitating of telegraphic intercourse between Gibraltar and France, was lately presented to both Houses of Parliament (No. C. 2,937). The substance of the agreement is as follows:—Article I. The charge for ordinary telegrams exchanged between Gibraltar and France, by way of Spain, is fixed uniformly at 25 centimes a word, without surtax. The entire sum collected on the one side and the other shall be divided between the three Administrations in the following proportions:—There shall be paid to Great Britain (Gibraltar), 5 centimes; to Spain, 10 centimes; and to France 10 centimes a word. Article II. The preceding provisions are applicable to the correspondence exchanged between Gibraltar and Algiers (or Tunis), by way of the direct cables between France and Algiers. There shall be collected, however, for such correspondence an additional charge of 10 centimes a word, to be paid exclusively to France for the submarine transit between the coasts of France and Algiers. Article III. The rules of the International Telegraph Convention for the time being in force are applicable to the relations between the British possession of Gibraltar and France, in all that is not regulated by the foregoing articles. Article IV. The present agreement, which is intended to come into force at a date to be agreed upon between the three Administrations (1st July last), shall form, with the International Telegraph Convention of St. Petersburgh and its service regulations revised at London, the whole of the arrangements to be observed in the telegraph relations between Gibraltar and France (Algiers and Tunis included), by way of Spain. It shall remain in force for an indefinite period, and until the expiration of one year from the date on which notice of its determination shall have been given by one of the contracting parties.

THE METROPOLITAN TELEGRAPHISTS.—The following letter appeared in some of the morning papers on Tuesday last:—"Sir,—The metropolitan district telegraphists have forwarded to the Postmaster-General a petition asking for an improvement in the scheme recently promulgated for the purpose of removing what have been acknowledged to be well-founded grievances. The memorialists point out (1) that the maximum salary now attainable in the districts is only £140 per annum, notwithstanding that hitherto it has been £160, and in the central office it has been increased to £190 per annum; (2) that they entered the service under the same conditions as the telegraphists in the central office, it being a mere chance whether on entry a clerk is sent to the central office or to any one of the districts; and (3) that besides having to perform the same telegraph duties as the clerks in the central office they have other duties of which the clerks there have no knowledge, and which involve additional responsibility. The memorialists further call attention to the fact that in the districts clerks with eight, nine, and ten years' service are receiving the same pay as clerks in the central office who have served only four and five years. These inequalities, they contend, are the inevitable result of a system of classification, and therefore, in consideration of the fact that the work of a second class clerk is exactly the same as that of one in the first or senior class, they ask that classification, or the barriers to promotion from one class to another, may be entirely abolished, that they may enjoy the same prospects of rising as the clerks in the central office, and that those who, through accidental circumstances, have been debarred from promotion may be placed now upon an equal footing, as regards salary, with clerks in the central office who have served an equal length of time.—Yours, &c., F. Orson Wood, chairman and secretary Metropolitan District Committee, 13, The Parade, Shepherd's Bush, Aug. 1."—In a further letter to *The Times*, dated the 3rd August, Mr. Wood makes the following additional remarks:—"Telegraphists in the districts with ten and eleven years' service, who have been at a standstill for years at the maximum of the old third class (£65 per annum), are now receiving only £70 per annum. Some of these clerks were chosen to fill vacancies in the districts solely on account of their superior ability. Had they exhibited less skill, they would, in the ordinary course, have been sent to the central office, where at the present time they would be receiving £85 or £90 per annum. Their juniors in service in the central office are far ahead of them so far as pay is concerned, and have a far better prospect of promotion under the provisions of the new scheme. Telegraphists in the districts had a form given them before making application for admission to the service, in which they were told they would have a prospect of rising to £160 per annum, whereas according to the new scheme £140 per annum is the highest salary attainable. Many of the clerks in the districts have been at a standstill from three to eight years at £90 per annum. In two years' time they will be receiving £100 per annum, with the prospect of again waiting an indefinite number of years for further promotion. Telegraphists in the districts are called upon to perform two hours' duty every Sunday without payment, whereas in the central office every hour's work performed on Sunday is paid for as overtime."

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BROOKS'S SYSTEM OF INSULATION.

The following are results of tests taken with the recently-laid wires from Waterloo to Clapham, insulated under this system. We leave the figures to speak for themselves, merely saying that although the insulation is low, experience seems to teach that it is practically constant—a very favourable feature.

The following are the results of the tests taken at Clapham Junction on the 27th ult:—

To QUEEN'S-ROAD.

No. of Wire.	Capacity per Mile.	Insulation per Mile.
1	·48653	3·056
2	·47521	2·817
3	·46390	2·711
4	·47521	2·522
5	·47521	2·753
6	·48653	2·862
7	·45258	2·956
8	·47521	2·885
9	·48653	3·005
10	·48653	*1·639

To VAUXHALL.

1	·44555	3·126
2	·45071	2·093
3	·45071	1·782
4	·45071	2·060
5	·44555	3·126
6	·44555	3·198
7	·45071	3·126
8	·44555	2·060
9	·45071	1·498
10	·44555	1·998
11	·45071	3·126
12	·43936	3·060
13	·45071	3·126
14	·44555	2·198
15	·44555	3·126
16	·44555	3·126
17	·45793	3·126
18	·45793	3·126
19	·45071	2·198
20	·44551	2·060
21	·43318	2·060
22	·44555	1·998
23	·45793	2·198
24	·44555	3·126
25	·42699	3·126
26	·42699	2·273
27	·45071	2·198
28	·45071	3·126
29	·44555	2·060
30	·45071	3·126

These wires were extended to Waterloo immediately after the tests were made. Tests of the whole length follow.

The following are the results per mile of the tests on Brooks's cable taken at Clapham Junction last night by Mr. Hawkins, of Silvertown, and Mr. J. B. Chapman, of the Postal Telegraph Department:—

QUEEN'S-ROAD SECTION, LENGTH 1·3257 MILES.

No. of Wire.	Capacity Microfarads.	Insulation Megohms.
1	·45104	2·516
2	·45920	2·914
3	·42858	2·873
4	·44593	2·738
5	·44899	3·069
6	·44696	3·116
7	·42655	3·241
8	·44287	3·293
9	·44389	2·957

The tenth wire, being in use, could not be tested.

* This wire was tested immediately after working had ceased being used for Goodwood Race week.

One of the above wires, which was not identified owing to the absence of numbers when tested on a previous occasion, immediately after it had been released from a working circuit, gave an insulation of only 1·639 megohms, but now it had much improved, the lowest result being 2·516 megohms

The following tests were also made to Waterloo, distance 3·76 miles. Allowing 5 per cent. for the lay of the cable, the actual length of wire is 3·94 miles.

No. of Wire.	Insulations per Mile. Megohms.	Capacity per Mile. Microfarads.
1	3·913	·31725
2	3·967	·31005
3	3·196	·31005
4	3·967	·31365
5	3·699	·31725
6	3·454	·31365
7	3·913	·31725
8	4·080	·31005
9	3·887	·29930
10	4·023	—
11	3·017	—
12	3·017	—
13	3·583	—
14	3·583	—
15	3·699	—
16	3·825	—
17	3·887	—
18	3·927	—
19	3·723	—
20	2·675	—
21	3·851	—
22	4·051	—
23	3·699	—
24	4·023	—
25	4·720	—
26	4·095	—
27	3·723	—
28	3·954	—
29	3·967	—
30	4·124	—

It was not considered necessary to take capacity tests on the whole of these wires, as all are doubtless nearly alike. The lower result shown in the tests for capacity of the long length is due to the low insulation and the consequent rapid loss of charge.

The natural current in this cable is much more apparent than in ordinary ones, owing to the dielectric being a liquid. Its electromotive force was not measured, but is not sufficient to produce an effect on any but most delicate instruments.

THE EVOLUTION OF DYNAMO AND MAGNETO ELECTRIC MACHINES.—VI.

By γ. β.

(CONTINUED FROM PAGE 102.)

The postponement of the opening of the Exhibition at Paris, and, consequently, the postponement of the report of the exhibits enables me to return to a subject the history of which grows more and more interesting with the development of dynamo and magneto machines. Attention might well be called to the fact that the earliest experimenters and designers were all imbued with the idea of obtaining power economically to utilise in doing work. The cutting of wood, the pumping of water, the driving of boats, and generally the production of motion in trains of machinery was the goal at which they aimed. This was their primary object. To-day it is the secondary object, the economic production of electric currents for lighting purposes being the immediate and primary objects of inventors. So far as we know there is no recent inventor whose machine has been devised principally for any other than electric lighting purposes, and if we read

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Professor Perry's lecture given before the Society of Arts aright he hints that the best machine for ordinary lighting purposes is not necessarily the best machine for every purpose. It may be, then, that sooner or later it will be necessary to discuss the different types of machine as designed for different purposes, just as the mechanical engineer discusses the type of locomotive as designed for goods trains as contrasted with the type designed for express traffic. The principle of both is the same, but the details are different. By and bye in these desultory articles we may, perhaps, make an attempt at classification. Meanwhile we resume our history. The illustration of Jacobi's machine, p. 101, shows how he used magnets in combination, and we have seen how he applied his apparatus to the propulsion of a boat on the Neva.

Passing from Europe to America, and premising that no attempt is here made to note every machine or every modification, we shall speak first of the work of Mr. Thomas Davenport, of Bandon, Vermont. The work of Professor Henry will be mentioned hereafter. A writer in *Silliman's Journal* for April, 1837, says of Davenport's machine "that it is composed of two iron bars placed horizontally, and crossing each other at right angles. They are both five and a half inches long, and they are terminated at each end by a segment of a circle made of soft iron; these segments are each three inches long in the cord line, and their position, as they are suspended upon the ends of the iron bars, is horizontal.

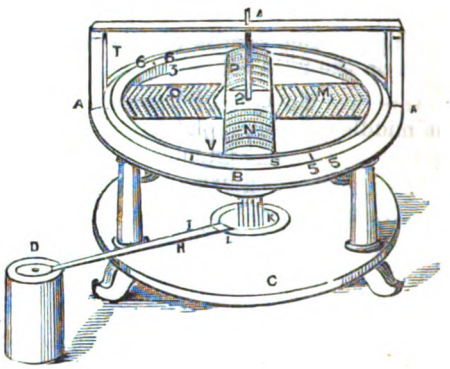
"This iron cross is sustained by a vertical axis standing with its pivot in a socket, and admitting of easy rotation. The iron cross bars are wound with copper wire, covered with cotton, and they are made to form, at pleasure, a proper connection with a small circular battery, made of concentric cylinders of copper and zinc, which can be immersed in a quart of acidulated water. Two semicircles of strongly magnetised steel form an entire circle interrupted only at the two opposite poles, and within this circle, which lies horizontally, the galvanised iron cross moves in such manner that its iron segments revolve parallel and very near to the magnetic circle and in the same plane. Its axis at its upper end is fitted by a horizontal cog-wheel to another and larger vertical wheel, to whose horizontal axis weight is attached and raised by the winding of a rope. As soon as the small battery destined to generate the power is properly connected with the machine and duly excited by diluted acid the motion begins by the horizontal movement of the iron cross with its circular segments or flanges. By the galvanic connection these crosses and their connected segments are magnetised, acquiring north and south polarity at their opposite ends and being then subjected to the attracting and repelling force of the circular fixed magnets, a rapid horizontal movement is produced, at the rate of two hundred to three hundred revolutions in a minute, when the small battery was used. * * The rope was wound up with a weight of fourteen pounds attached, and twenty-eight pounds were lifted from the floor. * *"

In considering this machine the question of increased efficiency and limitation of power is discussed, and the conclusion arrived at is thus stated.

"That provided the magnetism of both the revolving cross and of the fixed circle can be indefinitely increased, then no reason appears why the energy of the power cannot also be indefinitely increased. Now, as magnets of the common kind, usually called permanent magnets, find their limits within almost the power of lifting a few hundred pounds, it is obvious that the revolving galvanic magnet must, in its efficiency, be limited by its relation to the fixed magnet. * *"

This conclusion led to the adoption of electro-magnets in the place of the fixed magnets. Hence his first machine had fixed permanent magnets and magnets and revolving electro-magnets, whilst the modified machine had both fixed and revolving electro-magnets.

The patent of Mr. Davenport's machine, granted in February, 1837, describes it as follows:—The frame A may be made of a circular, or any other figure, divided into two or more platforms, B and C, upon which the apparatus rests; and of a size and strength adapted for the purpose intended. The galvanic battery D is constructed by placing plates of copper and zinc, alternately, of any figure, in a vessel of diluted acid; there are two conductors, H and I, one from the copper and one from the zinc, in the vessel D leading to and in contact with copper plates, K and L, placed upon the



lower platform. These plates or conductors are made in the form of a segment of a circle corresponding in number with the artificial magnets hereinafter described. They are placed around the shaft, detached from one another and from the shaft, having a conductor leading from the copper plate of the battery to one of the said plates on lower platform, and another conductor leading from the zinc plate of the battery to the next plate on the said lower platform, and so on alternately (if there be more than two plates on said lower platform) around the circle.

The galvanic magnets M, N, O, P are constructed of arms, or pieces, of soft iron in the shape of a straight bar, horseshoe, or any other figure, wound with copper wire Q, first insulated with silk between the coils. These arms project on lines from the centre of a vertical shaft, R, turning on a pivot or point in the lower platform; said copper wires Q Q extending from the arms parallel, or nearly so, with the shaft down to the copper plates K and L, and in contact with them.

The galvanic magnets are fixed on a horizontal wheel of wood, V, attached to the shaft.

The artificial magnets S T are made of steel and in the usual manner. They may be of any number and degree of strength, and fixed on the upper platform, being segments of nearly the same circle as this platform; or, if galvanic magnets are used (which may be done), they may be made in the form of a crescent or horseshoe, with their poles pointing to the shaft. Having arranged these artificial magnets on the top of the upper circular platform, there will be a corresponding number of magnetic poles, the north marked 5 and the south pole 6. Now, we will suppose the machine to be in a quiescent state, the galvanic magnet No. 1 being opposite the south pole of the artificial magnets, the galvanic magnet No. 3 will, of course, be opposite the south pole No. 6, and the galvanic magnets No. 2 and 4 will be opposite each other, between the poles just mentioned.

There being a corresponding number of copper plates, or conductors, placed below the artificial magnets around the shaft, but detached from it, as well as from each other, with wires leading from the galvanic magnets to these plates, and in contact with them, as before described, these will stand in the same position in relation to the copper plates that the galvanic magnets stand to the artificial magnets, but in contact with the plates.

Telephones in Buenos Ayres.—*L'Electricité* says that M. Locht-Labye's pantelephone is being adopted in Buenos Ayres, side by side with the Blake and Gower bell telephones. The Minister of the Interior has established connection by this means with the chief municipal offices of the city, and the Ministers of War and Marine have also adopted it.

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ELECTROSTATIC INVESTIGATIONS.

BY DR. JAMES MOSER.*

The author has made some interesting investigations on the action of the Differential Inductometer and of the Electrophorus, varying the method pursued by Faraday in respect to the former. Instead of the three brass plates employed by Faraday Dr. Moser uses three zinc plates 30 millim. diameter, sometimes with the usual glass jar and two insulated gold leaves, but at other times two electroscopes connected respectively with the two outer plates. The author regards the three plates as two condensers having one plate, namely, the middle collecting plate, in common. From this plate the induction begins, and ends on the two side plates. In this arrangement the division of the induction corresponds to the division of the current in flowing electricity, for the electrostatic condition may be converted into a corresponding electrodynamic condition by placing a conducting liquid between the plates. The case, however, exactly corresponding to the inductometer, which the author regards as an apparatus for the division of induction, would be the branching of the current between three round plates. This, Dr. Moser considers, is substantially what is implied in Faraday's statement :—"Amongst insulating dielectrics some lead away the lines of force from others, as the wire will do from worse conductors." The methods for determining electrical resistance which are based upon divisions of the current may thus be applied to the measurement of inductive capacity. For example, between the inductric plate and each of the inducteous plates a metal plate may be introduced of equal potential, so that there are four divisions whose inductive capacities are proportional to one another in pairs. If the inductive capacity of one of these divisions be altered by introducing another dielectric than air, then the capacity of the other division must also be altered, in order to restore the original proportion. The capacity of this second division is changed by altering the distance between its limiting plates until the original equality of the electrical potential of the two middle plates is again reached. A quadrant electrometer connecting the two will then show no deviation; and thus the measurement of inductive capacity is, Dr. Moser considers, reduced to measuring a length.

A further instance of the branching or dividing of induction is found in the electrophorus. The instrument used by Dr. Moser consists of a circular ebonite plate, 1·5 millim. thick and 30 centim. diameter. The coverings are of zinc, and are of the same diameter, one of them being provided with an ebonite handle. For other purposes he used three plates of the same shape, of thinner ebonite, together with other plates of zinc of similar dimensions. Experiments with this apparatus lead the author to formulate the theory that "the electrophorus contains two inductive layers—one negative on the upper side, one positive on the lower side of the ebonite plate."

On the two sides of the ebonite plate the sign of the discharge is differently affected. 1. The ebonite plate lying close to the metal plate; the other, lifted, metal plate gives :—

(*a*) The rubbed surface being above, a positive discharge; (*b*) The unrubbed surface being above, a negative discharge.

2. The ebonite plate lying some height above the metal plate, we get, on the contrary, quite indifferently, whether (*a*) the rubbed surface, or (*b*) the unrubbed surface is above, in both cases positive discharges.

Thus we have the means of recognising not only—

(1) On which side an ebonite plate is charged positively;

(2) On which side it is charged negatively, but also

(3) Whether it had been charged originally negatively on the one side or

(4) Positively on the other side.

For this purpose the ebonite plate to be tested is placed close to an uninsulated metal plate. Then a second metal plate is put on the ebonite disc, uninsulated, and the electricity induced upon it tested; the opposite electricity will be found to exist in the upper surface of the ebonite plate. If the ebonite plate be now inverted, and again put close to the uninsulated metal plate, the kind of electricity upon the other surface of the ebonite is determined. Again, the ebonite plate may be tested at some height above the metal plate. At a certain height, whether the plate is face downwards or inverted, the electricity induced will be identical. If we join the cover to one electroscope and the sole to another, both electroscopes show a divergence on moving one of the plates, but in opposite senses; and through a conducting wire from the cover to the sole there flows a current on moving one of the plates.

As to the changes of induction in the interior of the electrophorus (which may be imagined as a polarisation of the dielectric) the author in conclusion adduces the following experiments:—"If the ebonite plate, put on the uninsulated base, is strongly excited, it attaches itself to the base. If now the cover is put on and both metal plates are uninsulated at the same time, it attaches itself to the cover, so that we can lift the plate by means of the cover. A current of positive electricity has flowed at the moment of uninsulating from the sole through the outer conducting wire to the cover. Before the current has flowed, the induction (polarisation) went wholly through the ebonite plate; after the current the inductive (polarising) effect, and the excited layer extends, for the greater part, through the thinner interval of air to the cover, and only for a smaller part of it through the thicker ebonite plate to the sole. Finally, I may mention an experiment in which branching of induction, as well as branching of conduction, may easily be observed. I beat the ebonite plate lying on the uninsulated base, and put on the excited surface of the first another equal, but not excited, ebonite plate, and then on this the metal cover. This cover being uninsulated and lifted, gave positive sparks, just as if there had been in place of the upper ebonite plate a corresponding layer of air. Immediately after this I tried the upper ebonite plate, endeavouring to use it alone as the disc of an electrophorus. But this trial did not succeed; the plate was ineffective. I afterwards repeated the experiment, laid the same plate again on the rubbed surface of the first ebonite plate, put on it also again the cover, but left the apparatus unaltered during twelve hours. In this case there is ebonite on the two sides of the inductric layer of the ebonite plate; induction extends from this layer through ebonite to the sole and to the cover. In the same manner the conduction—the penetration or absorption of electricity—must take place to both sides; and I expected that the negative electricity would penetrate not only into the lower ebonite plate, but would go over to the upper plate also. This is indeed what took place. After twelve hours the upper plate could be used as the disc of an electrophorus. Both plates gave now strong and, as it seemed, equal effects. As was to be supposed, the upper plate was negatively charged on its lower surface, with which it lay on the inductive layer, and had, therefore, to be inverted in order to give similar discharges to those of the first plate. If, now, we fix our attention specially on the upper ebonite plate, we find:—(1) That the effect of *induction* through it began almost instantaneously (for immediately after having laid this upper plate on the excited lower one I could put on, lift, and discharge the cover); and that this effect of induction had disappeared also almost instantaneously when I tried to use the plate alone for the electrophorus. But, further, we have seen (2) that slowly another *inherent* change took place: a penetration of electricity occurred which made the plate more duringly effective as an electrophorus disc."

* Abstract of paper read before the Physical Society. *Phil. Mag.*, Aug., 1881.

TELEGRAPHIC COMMUNICATION WITH LIGHTSHIPS.—In the House of Commons this week, Mr. Chamberlain, in reply to Mr. Akers-Douglas, stated that he was informed that the Trinity House were now in communication with certain manufacturers with regard to the practicability of establishing telegraphic communication between lightships and lighthouses and the shore, and they hoped to be able to announce a satisfactory result in a short time.

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THE ELECTRICIAN.

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ELECTRICITY AND THE TAILS OF COMETS.

One argument against the theory that the tails of comets are material is the incredible velocity with which these appendages must sweep through the sky when the comet performs its perihelion passage near the sun. It is well known that a comet's tail is always directed oppositely from the sun, almost in the prolongation of the radius vector. M. Faye gets over this difficulty by supposing that the tail of a comet is not a continuous whole, but a series of puffs successively emitted and chased by a repulsive force coming from the sun, no other connection existing between them but their common speed of translation. That there is some mystery in the nature of these singular trains is evident by the different theories which have been formed to account for them. Sir John Herschell likened the phenomenon to a *negative shadow*, a momentary impression made upon the ether which is behind the comet, and anticipated that science would one day explain them satisfactorily. He saw clearly that the sun appeared to exercise a repellent force on the matter of a comet's envelope and tail; but he could not explain it himself. Dr. Tyndall suggested that the tail is a similar effect to the illumination of a beam of light by certain chemical vapours. He supposed that the head of the comet allows a greater proportion of actinic than heat rays to pass through it, and that the actinic rays illuminate the gaseous matter of the tail. Professor Tait, again, drew an analogy to comets' tails from a covey of sea-birds wheeling into view by slightly changing their plane of flight; but all these are more or less unsatisfactory as explanations, and the opinion is gaining ground that a comet's tail is an electrical effect similar to the voltaic arc or the aurora borealis. M. Flammarion, the well-known French astronomer, argues very acutely in favour of this hypothesis. He points out that any molecule having a velocity greater than 608,000 metres per second will not pursue an orbit round the sun, because that speed is the greatest which the solar attraction can impress on any molecule. But the head of the 1843 comet moved round the sun with a velocity of 550,000 metres per second. At a short distance along the tail the molecules must have been moving with the above-named limiting velocity. What, then, must have been the repulsive force which could keep these molecules in the straight direction of the tail? Nevertheless, no signs of disturbance, dislocation, or breaking up of the tail of a comet are noticeable. It is, in the words of M. Flammarion, always homogeneous, plane, and tranquil as a simple beam of the electric light. If it constantly renewed itself by fresh particles or puffs, as M. Faye suggests, would there be no trace of this cast-off matter in the regions of space which the tail has left behind?

The extreme transparency of these luminous trains, as evidenced by stars even of the fifth magnitude being seen quite distinctly through them, as they are sometimes seen through the auroral light, is another argument in favour of the electric light hypothesis. Spectrum analyses, made on the light of the comet at the Observatory of Paris, show that the bright bands of glowing gases manifest themselves round the nucleus at nearly the same distance on all sides, "but disappear in the tail properly so-called." Mr. Huggins has found, at Tulse Hill, that the comet's nucleus is composed (in part at least) of carbon, hydrogen, and nitrogen; and in commenting on this result M. Berthelot, at the French Academy of Sciences, gave it as his opinion that they favoured the electrical theory. The state of combination of carbon, hydrogen, and nitrogen, and the presence of cyanhydric acid furnishes an argument in favour of this hypothesis. Acetylene is produced whenever carbon and hydrogen are in presence of each other and under the influence of the electric arc. If nitrogen is added cyanhydric acid is also formed. It is, he observes, no longer possible to imagine a continuous combustion of cometary matter, but an electric excitation is easy enough to conceive. The long tail of a comet would, on this hypothesis, be simply a luminous excitation of the ether.

CYCLONES AND CABLEGRAMS.

One of the most important conquests of science is the discovery of some of the laws relating to certain kinds of storms. It is now well known that certain tempests describe regular orbits of an almost parabolic form on the surface of the globe, having their apices from the twenty-fifth to the thirtieth degree of latitude, and their concavity directed to the east. Their movement of translation—at first slow, then more and more accelerated—is effected from left to right upon our hemisphere for an observer situated in the interior of that vast curve, and from right to left on the opposite hemisphere. It is by the second branch—that most distant from the equator—that the storms of America arrive in Europe; and it is by the first—that nearest the equator—that the southern tempests of the Indian Ocean strike successively the islands of Roderique, Mauritius, Reunion, and Madagascar.

This fact has suggested to M. le Commandant Bridet,

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formerly chief of the port of Reunion, that if a submarine cable were established between the Islands of Mauritius and Reunion it would be possible for the residents of Mauritius to warn Reunion of the direction of cyclones eighteen or twenty-four hours in advance of their arrival. This cable does not yet exist, but the same idea is carried out to some extent by Mr. Gordon Bennet, the proprietor of the *New York Herald*, by means of the Atlantic cables. The storms which leave the American coast on their parabolic course are now signalled to Europe several days in advance of their arrival there. Of course the great distance between America and England renders these warnings more or less uncertain, because some storms are spent ere they can travel so far, and others do not keep to the expected time.

No such uncertainty exists in the case of M. Bridet's proposal, which has just been brought to the notice of the French Academy of Sciences by M. Faye. The distance between the two islands is so short that the warnings sent from hour to hour from the Observatory of Mauritius to Reunion may be confidently trusted. To this end M. Bridet has addressed a letter to the Minister of Marine and Colonies soliciting his attention to the subject. Frequent disasters to lives, shipping, and other property now occur in Mauritius, owing to the cyclones coming unexpectedly, and these could be prevented by the proposed cable, for it would then be possible to inform ships when and where the centre of the cyclone would pass the island.

Of all the British Colonies Mauritius is the only one which has not been connected to England by a telegraph line; but it is certain that this state of things cannot continue, and Mauritius will, no doubt, ere long be put in connection with Zanzibar, or some other station of the Eastern Telegraph Company's lines to India and Africa. It will thus be in connection with England, and when the other cable is laid between Mauritius and Reunion that island will be put in telegraphic communication with the French capital.

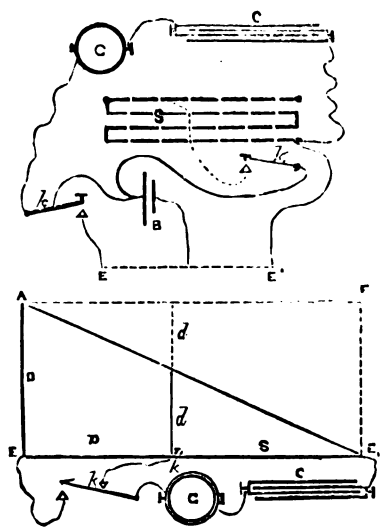
SECONDARY BATTERIES—MEASUREMENT OF INTERNAL RESISTANCE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Since the very striking results obtained by my friend M. Faure with his "Electric Accumulator," a considerable amount of attention has naturally been directed to the subject of secondary batteries; and it is to be hoped that the study of electro-chemistry—somewhat neglected in this country since the time of Daniell, and more especially since the death of his pupil W. A. Miller—will receive a permanent stimulus from the dashing initiative taken by the *Force et Lumière* Company. Not that I can quite agree with the view taken by your contemporary *La Lumière Electrique* that English electricians, generally, are so ignorant of this branch of their science as to have been unacquainted, until recently, with the construction and theory of the Planté secondary battery. Outside of the more exclusively mathematical school of electricians, there are in England, as well as in Germany, men whose knowledge of electro-chemistry is both profound and extended. *On ne le dirait pas!* it may be said. Well! we have all been taken somewhat by surprise; probably they did not think that the time had yet come for practical work in this direction, nor that the public would have been rendered so tractable in regard to an innovation which requires a great deal of "working out." M. Faure deserves both thanks and credit, in addition to success, for having shown the way; but it would be a mistake to suppose that, outside of his invention, there is in the land a total dearth of practical ideas in relation to the storage of electrical energy. On the other hand, it may be admitted that the Faure Accumulator possesses special advantages which are not immediately obvious, and that, out of a very large number of possible combinations, there seem to be very few that are at all likely to enter into successful competition with it.

But my present object is to afford a "wrinkle" to the student who may be inclined to study, of course on a very small scale, the "large number of possible combinations" that have just been referred to. I may be of use in saving some of the workers amongst the rising generation of electricians from a large amount of useless labour and failure, such as were incurred by one of their number who intended to test the electromotive force, internal resistance, and "staying power" of several forms of secondary battery, and who frankly confessed to me that he had never been able even to get an approximation to the internal resistance of any of these combinations. Those who know how difficult it is, by any of the more ordinary methods, to measure with any degree of accuracy the internal resistance of a Smee cell, a Clark standard, or a half-exhausted Leclanché, will readily understand the difficulty which is consequent upon the use, under conditions in which the E.M.F. varies from second to second, of a formula in which E is supposed to be absolutely constant.

The only known method of measuring the internal resistance of a battery which "polarises" badly, is a modification of the plan suggested by Mr. H. R. Kempe in the *Journal of the Society of Telegraph Engineers*, No. III., p. 419. The modification in question was described in the *Telegraphic Journal* of February 1, 1878. It is an excellent arrangement, but is open to the objections that the two "throws" are obtained on opposite sides of the zero on the scale, and that the condenser cannot be completely discharged through the galvanometer, so as to check the "throw" obtained when the battery is circuited. The method shown in the following diagram, which in great measure explains itself, will, I think, be found preferable.



To test the E.M.F., internal resistance, and "staying power" of a battery or cell (secondary or primary):—

1st. Insert at B a standard cell—say a Clark standard, of which the E.M.F. is (*pro. tem.*) taken as 1·457 volt. Then depress *k*, obtaining on the galvanometer the throw D_1.

2nd. Insert at B the cell or battery to be tested. Depress *k*, obtaining the deflection D. The (initial) E.M.F. of the cell is

$$E = 1{\cdot}457 \frac{D}{D_1} \text{volts.}$$

3rd. Unplug on the resistance coil a resistance (S) preferably about equal to the supposed resistance of the cell or battery. Depress k_1, obtaining the deflection d_1 due to the fall of tension over the internal resistance (E k_1, Fig. 2) of the cell or battery. Then this internal resistance will be

$$\rho = S \frac{d_1}{D - d_1} \text{ ohms.}$$

The student should particularly observe that the "throw"

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d_1 is obtained *the very instant* the battery is circuited through S, and consequently before there has been any loss of E.M.F. through "polarisation." He should also verify the fact that, when $S = \rho$,

$$d_1 = \frac{D}{2}.$$

4. To compare the "staying power" of different cells:—Unplug in the coil a resistance preferably equal to ρ, and hold down k_1 for a certain period of time—say five minutes. Then release k_1 and depress k, noting the loss (if any) of E.M.F. Or, S being equal to ρ, obtain the deflection d by depressing k whilst k_1 is still held down. If $d = d_1$ the battery has maintained a constant current during the given period of time; otherwise, the difference between the two may be taken to indicate the deficiency in "staying power."

The student should verify the fact that, in the case of a fairly constant cell or battery,

$$\rho = S\frac{D-d}{d} = S\frac{d_1}{D-d_1} = S\frac{d_1}{d}.$$

A reflecting electrometer may advantageously replace the galvanometer and condenser,

Yours, &c,

DESMOND G. FITZ-GERALD.

ON THE WORK-DUTY OF COUPLED DYNAMO-MACHINES.*

BY A. NIAUDET.

Most of the applications of the principle of the electrical transport of energy are carried into effect by means of two dynamo-machines; one (the source) controlling, and the other (the receptor) obeying.

It is not yet known what the conditions are under which the maximum work may be obtained from the receptor. The problem does not appear to be susceptible of a general solution; but, on the other hand, it is easy to ascertain what is the duty of the system.

We may separate the inducing electro-magnets from their respective rings, and excite them by means of two distinct sources, producing in each of the circuits a current of the intensity i. If, at the same time, we insert between the two rings a resistance equal to that of the two inducing magnets, the conditions will remain unaltered, and the current will still be i.

Now, this new system, which expends and supplies the same quantity of work as the first, may be assimilated to a system of two magneto-electric machines, in which case the duty is equal to the ratio of the electromotive forces. Consequently, the duty of the system of two coupled dynamo-machines is equal to the ratio of the electromotive forces of the receptor and of the source.

In regard to the determination of the two electromotive forces, this presents no difficulty. In order to ascertain that of (E) the source, we must excite the electro-magnets of this machine by means of a separate source, giving them the magnetic intensity they possessed in the system under consideration by making the current equal to i, and, lastly we must measure by any suitable method the E.M.F. of the current produced by the ring when rotating with the given velocity. The same method may serve to determine that of the receptor.

In the particular case of *two similar machines coupled together*, the magnetic intensity must be the same, since the electro-magnets are excited by the same current. This being the case, the two E.M.F. will be proportionate to the velocities of rotation, and, consequently, *the duty is equal to the ratio of the velocities.*

It should be understood that the duty for which we have here given a formula and mode of measurement is not at all the same thing as the duty which is measured by engineers. What has been spoken of is the electrical duty, viz:—the ratio $\left(\frac{w}{W}\right)$ of the electrical work done by the receptor, to the electrical work expended by the source. The duty considered by the engineer, or the practical duty, is the ratio of the effective work supplied by the receptor to the work absorbed from the prime motor by the source.

Now, the effective work supplied by the receptor is the difference between w, and the work (wf) absorbed by friction and other passive resistances; and we may call this effective work $W - wf$. And the work absorbed by the source will be $W + Wf$, if we call Wf the work absorbed by friction and other passive resistances in the machine constituting the source.

Consequently, the practical duty is equal to $\frac{w - wf}{W + Wf}$, and will be much less than the electrical duty $\frac{w}{W}$.

When, for instance, we find in the measurements given by M. Fontaine and published in *l'Electricien* of June 15, that the duty amounted to $\frac{50}{100}$, $\frac{51}{100}$, $\frac{52}{100}$, and up to $\frac{573}{1,000}$, we may conclude that the electricical duty has been as high as $\frac{70}{100}$.

I was under the impression that I was the first to point out that the duty is measured by the ratio of the electromotive forces in the case of dynamo machines, as in the well-known case of magneto machines; but, having consulted M. Mascart, he placed in my hands the notes of his course for 1881 at the College of France, in which the theorem is formulated. Perhaps some persons may be glad to have a demonstration without calculations which brings the case of dynamo machines under the same law which is applicable to magneto machines. I shall be glad if any of my readers would point out to me any prior publication of the same fact.

* Translated from *l'Electricien*.

FISH-BITE FAULTS IN SUBMARINE CABLES.

BY J. MUNRO, C.E.

It is now well known to telegraph engineers that the Para to Cayenne section of the Brazilian cables has been again and again interrupted by faults which were justly attributed to the attacks of fishes. Even now this valuable link in the chain of South American communication is electrically severed, and the cable lies utterly useless on the bottom of the sea. Having been incontestably bitten by some kind of fish before, the probability is that these depredators are accountable for the condition it lies in at the present time.

A good deal has been written about these interesting but fatal fish-bites, and several suggestions, or, rather, statements, have been made as to the nature of the animal which inflicted them, but it seems to the writer that the mystery is by no means cleared up yet. He was present during the laying and the first repairing of the Para to Cayenne cable on board the ss. "Hooper" and the ss. "Great Northern" as an electrician, acting for Sir William Thomson and Professor Fleeming Jenkin, F.R.S., and he carefully examined all the faults in this cable in order to report officially upon them. The cable itself, composed of Hooper's core, with the usual main, intermediate, and shore-end sheathing, was laid in 1874 from Para, on the Amazon, to Cayenne, French Guiana,* a distance of some 630 nautical miles. The cable was intended to be laid through to Demerara, further north, with a leg or branch into Cayenne. Accordingly a T piece was submerged, with the leg directed to Cayenne, and the arm for Demerara was sealed and buoyed until the shore end had been landed at the French port. This was successfully accomplished on July 6, and the following day the "Hooper" picked up the sealed end of the T piece with intent to continue the laying into Demerara, but on testing the Para to Cayenne section which had just been laid it was found to be faulty, although the final tests the day before had proved it sound. The "Hooper" then put back to Cayenne and Para in order to make further tests, and the fault was localised at a point 126 miles from Para.

During the subsequent repairs made by the "Great Northern" at least four indubitable fish-bite faults were cut out of the core, and a number of places were overhauled where the iron sheathing had been forcibly crushed up and distorted from the core as if by the powerful jaws of some marine animal. All these bites were observed within a length of thirty or forty miles, skirting the coast of Marajo, an island in the estuary of the Amazon. Three of them were in the intermediate type of cable, and the fourth was found in the deep sea or lighter type. Their

* For a popular account of the expedition see our last volume.

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general distance from Para was, roughly speaking, about 130 miles.

In the first of these faults (as the writer has elsewhere reported) the iron guard wires were bent aside so as to lay bare the jute serving immediately surrounding the core; and in the middle of the exposed part a piece of bone, apparently the splinter of a fish's tooth, was found stuck fast through the jute into the rubber core. On the same side of the cable, about two inches further along, another similar piece of bone was found in like position. Each of these splinters was nearly an inch long, tapered like a tooth, and about one-eighth in diameter at the middle. A second fault had one wire bent inwards, and the rest slightly displaced from their helical positions. In this fault, when it first came out of the sea, a sharp triangular fragment of tooth enamel, about a quarter of an inch across, was found by one of the men sticking between the wires; and on stripping the core bare a minute hole, like the puncture of a pin, was found in the insulator. A third fault was of a more mysterious nature. To external appearance there was nothing wrong with the cable; but when the outer serving was removed, and the core exposed, a hole in the core as large as the head of a pin was visible, and it was filled up with a white, putty-like substance. One yarn of the inner serving was then found to be divided just over this hole, and the iron wire which covered it in the lay was there found slightly bent, as well as at a point about *two inches* further off, about the same distance, in fact, as the space between the two teeth on the same side of the first fault. This distance may, therefore, measure the width of the animals jaws at the point where the teeth entered the cable. On slicing the core away at the fault, so as to lay bare the copper conductor, more of the soft, crumbly paste was found on one side of the wire; and two small fragments of hard bony matter were imbedded in one end of the divided inner yarn. They showed no signs of decay, and it was difficult to say whether they were bone or shell; but the paste was evidently dental matter decomposed, and their fibrous, semi-lucent appearance, together with the displacement of the sheathing, made it probable they were of bone. The fourth fault yielded no fragment of teeth, but the way in which the guard wires had been crushed up proved it to have been caused in the same way as the others. A fifth fault cut out about half way between Para and Cayenne showed a punctured core filled with a black material, and the copper wire was slightly indented; but it would be hard to say whether it was made by a fish tooth, or some metal point.

Mr. Warren has told us how, after these faults were removed, the cable was again found faulty in 1875, about the same place, and five more fish-bites excised. From one of these was taken "a large piece of bony substance, about 1½ inch in length, the part in the cable measuring something like one inch round." He then goes on to say that he was at a loss to identify the fish which caused them until he got to Demerara, where he had no hesitation in attributing them to the teeth of the saw-fish, which abounds in the sea along the northern coasts of Brazil. The saw-fish, he supposes, comes in contact with the cable while rifling the mud with his saw, and getting enraged at it, hits the obstruction with his saw, thereby causing the teeth to penetrate the core.

Now, it seems to the writer that this hypothesis cannot wholly explain the origin of these curious faults. It fails to satisfy all the evidence at our disposal. The saw-fish, we know, or at least believe, has made attacks on cables laid between Penang and Singapore; and the late Mr. Frank Buckland, in reporting on one of these faults, made the observation that "if it had been an ordinary fish, such as a shark, there ought to have been the marks of a bite on *both* sides of the cable, namely, of a tooth in both the lower and upper jaws. This wound, therefore, must of necessity have been made by a fish having but one tooth, and one tooth only; but what fish is there that has only one tooth? For several weeks I kept the specimen on my mantelpiece, and was constantly thinking over the puzzle. At last one day I hit it off all in a minute. On going round my museum I observed with most intense interest a beak or saw of a fish (*pristus antiquorum*) presented to me by Mr. Day, Inspector of Indian Fisheries, the fish having been taken in the Andaman Islands. 'That's the fellow,' I said to myself, 'that made the hole in Mr. Latimer Clark's telegraph cable.' So taking one of the teeth out of the beak of the saw-fish, I placed a spare portion of the telegraph cable on the table, and struck the end of the tooth with a mallet, and immediately produced a wound almost, I may say exactly, similar to that found on the Penang telegraph cable." On the strength of this conclusion it has become the habit to refer these Penang to Singapore faults, and also it would appear the Para to Cayenne ones, to the saw-fish; but in the latter case at least the given facts are inconsistent with the theory.

For in the first place the Para to Cayenne faults showed that the cable had been actually crunched between the jaws of some voracious fish, as proved by the distorted wires and pieces of teeth found on *both* sides of the cables. The cable in short was bitten, not struck, and when it is borne in mind that along the Para to Cayenne coast the cable lies comparatively slack at some places on the bottom, and at others, where it passes over the barrier reef, it is probably slung between jutting piers of coral, it will be seen that a fish could readily get the tempting bait into its mouth.

The positions of the three teeth in the first fault cut out are rather significant. On one side there were two teeth about two inches apart, and on the other side of the core, about midway between these, was a third tooth, or rather piece of tooth. Now, this may mean that the fish bit the cable *square on*, as it were, with the fore part of its mouth, so that two opposite side teeth and a single front tooth were left in the core. It seems even more likely, however, that the fish really took a sidelong bite at the cable as it swam beside it, so that two teeth of one jaw and a third tooth of the opposite jaw, on the same side of the head, were broken off. This mode of biting would also give the fish a greater crushing power than the other mode. If it was the true one, it might well be that the width of the teeth apart, as found in the cable, might be a measure of their relative positions in the animal's mouth.

I have been led to reconsider this question on reading an account of the *Plagyodus ferox*, one of the most formidable of deep-sea fishes, in Dr. Günther's "Introduction to the Study of Fishes." Varieties of this fish are known to haunt the seas round Madeira, Tasmania, Cuba, and elsewhere, so that it probably exists along the coast of Brazil. It grows to a length of 6 feet, and feeds on a variety of fare, including the armed cuttle-fish, crustacea, ascidians, boarfish, mackerel, and even the young of its own species. To these dainty morsels may, perhaps, be added submarine cables, for the teeth of the creature fulfil the requirements of the Para to Cayenne faults. Its powerful jaws are armed at intervals with triads of dagger-like tusks, and between these are smaller saw-like teeth, which fill up the gaps. Now, the longer pieces of teeth taken from the first cable fault appear to correspond with these longer tusks, and the little triangular fragment found in the second fault may be a broken tooth of a smaller kind. The *Plagyodus ferox* is believed never to rise above a depth of 300 fathoms, but this is only a belief; while the Cayenne cable lies in much shallower water. However, whether this be the true marauder or not, it is, I think, proved that these faults are not due to saw fish, and there is a practical gain in the deduction; for, in repairing the old cable, or laying a new one, it will be advisable to take a wider circuit out to sea, so as to keep the cable clear of the coral reef. For if it be not the saw fish the animal will not, perhaps, be able to bite it when lying flat on a smooth sandy bottom; and it is also probable that the fish in question will not be found away from the caverns and recesses of the coral reef where so much food for it abounds. The old cable ought, in fact, to be raised and relaid further out to sea, in the deeper waters, and on the clear sandy bottom indicated by the preliminary soundings of my friend Mr. Lindsay Galloway.

In conclusion it might also be suggested that some steps should be taken to find out for certain the true nature of the fish which has attacked this cable. The knowledge would not only have a scientific but a practical importance. For if he knew the habits of the animal and its haunts, the cable engineer would then be in a position to resist its attack, or at all events to give it a wide berth.

SUBMARINE TELEGRAPH COMPANY.

The half-yearly meeting of the proprietors in this undertaking was held at the City Terminus Hotel on the 3rd inst., under the presidency of Sir James Carmichael, Bart.

The SECRETARY (Mr. S. M. Clare) read the notice convening the meeting, and the report of the directors was taken as read. It stated that the accounts for the six months ending 30th June last showed a net balance of £38,077 18s. 8d. in favour of this Company, which enabled the directors to add 10 per cent. of the gross receipts to the reserve fund, and to recommend a dividend at the rate of 19 per cent. per annum. In accordance with the terms of the resolution passed at the meeting of the proprietors on the 11th February, 1879, the directors had treated in the accounts this Company's proportion of the cost of the new offices in Throgmorton-avenue as an asset of the reserve fund, and had charged the fund with the expenses incurred in the removal from Threadneedle-street. Interest at the rate of 4 per cent. per annum upon the whole cost of the building had been debited against rent and taxes, and carried to the credit of the reserve funds of the two Companies proportionately. The directors proposed to debit rent and taxes with a similar charge in future accounts.

The statement of joint earnings showed that the amount received during the half year had been £68,356.

The CHAIRMAN said he trusted they would consider the report full and satisfactory. They would all remember that as far back as February, 1879, when they proposed to build their new offices, he told them that in all probability when they were completed the rental of the Company,

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including ground rent and taxes, and the interest on the capital spent on the building, including all incidental expenses, would not exceed, or only to a slight amount, the rental they were at that time paying to the Post Office for their offices in Threadneedle-street. Well, the building was now completed, the Company was occupying it, and all the expenses in connection with it were paid, and he was happy to tell them that when they had let off two rooms on the ground floor, one of which had already been taken by the Post Office, he thought that the total annual cost of the new building would be nearly £200 a year less than they were paying formerly, he thought that that was a satisfactory result of their moving to London-wall, and it was to be remembered also that they had acquired a very valuable and very improving property, which he considered a very excellent investment for their reserve fund [hear, hear]. It was his intention on that occasion to propose a resolution to register the Company under the Joint Stock Companies' Act, 1862. The object of that was simply that under their royal charter they only had power, as he thought he had formerly explained to them, to acquire land and buildings to the value, of £1,000 a year. Therefore, as the present building very much exceeded that amount in value, they were beyond the powers of their charter. They asked them on a former occasion for authority to apply for a supplemental charter to authorise this additional outlay, but under the advice of their solicitor they found that the necessary legal expenses to obtain the supplemental charter would be very heavy, and that these expenses might be entirely avoided by the simple act of registering the Company under the Joint Stock Companies' Act, 1862, by which means they would have the power to buy any amount of land. They would, therefore, attain the same end by a much less expensive method, he did not know that there was any other point for him to touch on, except to remind them that at the last general meeting they authorised the directors to propose some scheme for the formation of a relief or benevolent fund for their staff. Their worthy secretary had given very great attention to this matter. They had had reports from all the other telegraph companies on what they were doing, and statistics had been brought under their notice concerning the subject. There was, however, a difficulty in the matter so far as regarded this Company, because the other companies had started from the beginning, and on the principle of what they might call an endowment fund, to which the clerks themselves paid half and the company the other half. That would have been a very good arrangement for this Company if they had started it thirty years ago; but they had now been working for thirty years, and many of their *employés* had arrived at an age when it would be unfair to ask them to contribute to an endowment fund. They were, however, informed that one of the clauses of the deed of settlement gave the directors power to compensate any *employé* of the Company in the event of his becoming disabled. The question rested with the proprietors, and if they left the matter with them on this ground they would carry it out to the best of their ability. The repairs to their cables were rather heavier than usual in the past six months, but that was a matter as to which they could never tell what the amount would be from one half year to another. In the previous half year they were very lucky—they had very few repairs—but in the last half year they had had to put in eight miles of new cables between Holland and Lowestoft. That cable was now in very good order, and he might add that all the cables in the Company's hands and worked by them were in excellent order. He then moved the adoption of the report and accounts.

The Hon. ASHLEY PONSONBY (director) having seconded the motion,

Mr. TOWNE referred to the increase in the wages in the past half year. He afterwards stated that he had taken the trouble of going through the securities held by the Company for the reserve fund, and had found that, as compared with the present market prices and their original cost, the Company had made a gain of £10,000. This showed the careful manner in which directors had invested the money for the reserve fund.

The CHAIRMAN stated that the increase in the wages had arisen entirely from the increase in their business. A larger number of messages had been forwarded, and they had consequently been compelled to employ an increased staff. He, however, rather hoped that that state of things would continue. He believed that Mr. Towne was quite correct in what he had said respecting the improvement in the reserve fund. All their securities were more valuable than when they were bought. He was glad to say that the reserve fund was now getting up to a respectable sum—£92,000.

Mr. FORDE congratulated them on the increased prosperity. At their last meeting he referred to the establishment of a fund for the benefit of their clerks, and he could not help feeling that the time had now arrived when they should give their *employés* some substantial reward for their services. At the same time, he could not say that he altogether liked the proposal indicated in the report. No doubt the directors had thought the matter well over, but he maintained that the proprietors should not leave an indefinite responsibility in the hands of the directors, which might cause discussion at future meetings. He would rather see a certain sum of money voted to a special fund which the directors should have complete control over. He thought as they were very late in the day in doing something for their staff that they should transfer a certain sum of money from the reserve fund and form with it a special reserve fund, which would be entirely at the discretion of the directors to use on behalf of the *employés* as they should think fit. They must be the best judges. He thought they should transfer to a special fund £2,000 out of the £92,000 now at the credit of the reserve fund and authorise the directors to add £400 to it every half year. That would give them a fair amount, out of which they could relieve the staff. With their permission he should be happy to move a resolution to that effect. Having read the resolution, he said he did not think that it was an extravagant proposal to put before the shareholders. They were receiving their 19 per cent. dividend, and having it pretty regularly, and he saw, too, that the profits were increasing.

Mr. TOWNE said he saw no necessity for Mr. Forde's proposal, seeing that the directors, as the report stated, had full power, under clause 87 of the deed of settlement "to make such compensation as they may think fit to any of the clerks, agents, and servants of the Company without any special resolution of the proprietors."

The SOLICITOR read the clause, in order that they might have the matter fully before them.

A SHAREHOLDER said he doubted very much whether the directors could touch the reserve fund for the purpose.

The SOLICITOR replied that they could not do so, but they could provide the compensation out of the reserve of the Company.

Mr. A. J. OTWAY, M.P. (director) observed that it was always very gratifying to the directors to have a mark of confidence such as was desired to be bestowed on them, but where there was no necessity for it he thought it was almost a pity that they should do anything which would create controversy. Under the Company's statutes the directors had full power to reward the *employés* of the Company in the manner they thought fit, and the wish of the directors would be to act in a fair and liberal spirit, having regard to their duty to the shareholders. The objection to the proposal made (by Mr. Forde) was this—that, irrespective of touching the reserve fund, which to his mind was a fund that should be preserved for the purpose for which it was formed, if they allotted to a certain number of the directors, who were fallible men, a given amount of money, they would want to spend it, and those who knew that the sum was allotted for their benefit would at once consider that they had a claim on it. They had far better leave the matter in the hands of the directors, whose interest it was, even more than that of the shareholders, to be surrounded by a trustworthy body of *employés*.

A SHAREHOLDER asked if it would not be better to suggest a certain sum to the directors.

Another SHAREHOLDER thought that the question had really better be left with the directors. This view of the matter was ultimately acted on, and

The CHAIRMAN having, in reply to a question, stated that any amount used for the purpose would be shown in the accounts, the matter dropped.

Some discussion followed as to the advisability of meeting at the offices of the Company, instead of at the hotel; and it was decided that this course should be adopted if they found that there was sufficient space for the purpose.

The CHAIRMAN then put the motion for the adoption of the report and accounts, and it was carried unanimously. He then proposed the dividend recommended, payable on and after the 1st proximo.

Mr. FORDE seconded the resolution, and it was carried unanimously.

On the motion of the CHAIRMAN, seconded by Mr. PONSONBY, the retiring directors (Sir Julian Goldsmid, Bart., and Mr. Otway, M.P.) were re-elected, as were also the auditors, Mr. G. C. Capper, Mr. W. B. Cole, and Alderman Sir Thomas Dakin.

The CHAIRMAN then moved the following resolution:—"That in lieu of applying for a supplemental charter, as authorised by the resolution passed at the half-yearly meeting of the proprietory held on the 11th February, 1879, the directors be authorised to register the Company under the Companies' Acts, 1862 to 1880, as a company limited by shares, for the purpose of giving the Company further powers to purchase or take on lease or erect suitable premises for carrying on the business of the Company."

Alderman Sir T. DAKIN seconded the motion, which was carried unanimously. He then moved a vote of thanks to the chairman and directors.

Mr. FORDE seconded the motion, which was carried unanimously.

The CHAIRMAN briefly acknowledged the vote, and the proceedings then terminated.

GLOBE TELEGRAPH AND TRUST COMPANY (LIMITED).*

The eighth ordinary general meeting of this Company was held on the 29th of July, at the City Terminus Hotel, under the presidency of John Pender, Esq.

The CHAIRMAN in opening the proceedings formally requested the Secretary to read the notice convening the meeting.

The SECRETARY (Mr. William Payton) having accordingly read the notice,

The CHAIRMAN said: Gentlemen, you have had the report in your hands for some days, and I presume you will take it as read [hear, hear]. [The report has appeared in *The Electrician*]. I shall, as usual, go over a few of the details, so as to give you a little more information than is contained in the report. I will first refer to the little alterations which have taken place during the past year. An examination of the balance-sheet shows we are much in the same position as we were last year—viz., we are again able to pay four-and-a-half per cent. on the ordinary shares, and this notwithstanding that our dividend from the Anglo-American Company has been but 3½ per cent. this past financial year as against 5 per cent. in the year ending July 18, 1880. Our financial position has been maintained by increased dividends from the Brazilian Submarine, the Eastern Extension, Eastern, Germar Union Telegraph Company, and the Indo-European Telegraph Company, and the prosperity of these companies will counteract to some extent the loss of revenue which may result from competition across the Atlantic. The more, therefore, we can make exchanges of our shares for shares of these companies the greater will be the security for our ordinary shareholders. The operations of exchange during the past year have been the following. We have exchanged 1,000 Telegraph Construction shares for 3,000 Eastern shares, and have also acquired a further 1,000 Eastern shares in exchange for our ordinary and preference shares. I may mention that this exchange is one which we were rather anxious to to make on account of the decidedly improving position of the Eastern Company, and we see no reason why that company's shares should not go considerably higher. Since the exchange was made they have increased something like ¼ to ¾ per cent. Eleven German Norwegian shares have been drawn for payment off at par, and you will observe on the payment side of the revenue account that we have lost a little by the exchange in remittance from Germany. So far for the securities. As regards the payments, they are shown more in detail than on former occasions, and the printing and stationery form a rather large item—£198; but the fact is we have had to order a new set of registers during the past year, which have cost £100, and the amount under this head will be proportionately less next year. As regards the general office expenses, £241 18s. 9d., these comprise a large item for accountants' charges in checking the registers and dividend payments after

* A full report of this meeting appeared in our Special Edition last week.

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the payment of each dividend. The utmost caution is observed in dealing with these cash matters, and it would be a false economy, perhaps, to diminish it. The salaries show an increase of £110 over last year, but the number of shareholders has increased, and an increase in the staff has become necessary. Last year I stated that the number of the shareholders was 5,400. I give you also a statement of the progress from the beginning in the number of the shareholders, and I may mention that during the last 12 months 600 additional shareholders have been added, so that we have now 6,000 shareholders on the register. I give these details to show exactly how the money has been spent, and that we exercise a reasonable economy, as indeed should be the case in a Trust Company. To show that the Globe shares still retain their favourable character as an investment, the aggregate value of the Globe shares taken at present market prices may be stated at £3,143,525, while the market prices of the securities held by the Trust is £2,958,077, a difference of over 6 per cent. in favour of the Globe shares. The amount of English capital invested in submarine cable enterprises may be stated at 26 millions of pounds, with a mileage of 66,000 miles. The mileage of the companies in which the Globe Trust holds shares is 47,563 miles, or a little more than two-thirds of the whole. This shows the Globe invested capital has a wide basis of security for the ordinary shareholder. It will be necessary for the shareholders to elect another auditor in the place of Mr. Newmarch, who, through illness, is no longer able to represent them. Now, gentlemen, I have given you some details so as to show you how the company has progressed during the past year. As you are aware, this company depends entirely on the good management and the success of the companies whose shares we hold. I am glad to say that the Eastern and the Eastern Extension show very great vitality, and I have no doubt that we shall by degrees reap increased dividends from these companies. We are, however, threatened on the other hand by competition in the Atlantic. Now I think it is right to say to you, gentlemen, that looking at the traffic that passes over our present lines, looking at the improvement in trade in America, and the growth of telegraphic communication throughout the world, I have no great fear that any competition is likely to affect us materially [applause]. I believe that when the Americans have laid down their cable there will be room for them as well as for Englishmen. The only thing that astonishes me is that the Americans, with all the progress that has been going on there for some years, have not long ago endeavoured to participate in the telegraphic communication across the Atlantic; and if they will only conduct their business in a business-like way, and without reference to Stock Exchange operations, I have not the slightest doubt that they will get a fair dividend on their investment, and that the results will be generally beneficial to commercial enterprise. But, gentlemen, the companies in which we are interested have been constantly taunted with being great monopolists, and we are told that we hold the Atlantic in our own hands, and that we have used it really for our own purposes. Now, I think I may say, without fear of contradiction, that had we been monopolists we should have been paying very much larger dividends than we are at present. From the beginning, from the inauguration of submarine telegraphic enterprise, the rates have steadily gone down. The Atlantic Company started, for instance, with a rate of £20 for a message. We are now down to-day to 1s. a word. In every change that has been made, and in every arrangement that has been made with any competing company, the advantage to the general public has been very much larger than it has been to the individual shareholder. I have no fear of competition doing us much harm, or that the word "monopoly" is at all a word that is likely to be accepted by sound thinking men as a definition of our position. Now, there has been a desire expressed lately that America, in her progress, should really become the controller of submarine telegraphy. I have no objection to their becoming the controllers if they choose to pay for it, and at the same time I am perfectly satisfied that the enterprise of Englishmen is such that, having been the pioneers in this great system, they are not likely to give it up without some very good cause. If the leaders of the enterprise which is in the ascendant at the present moment in the United States (more particularly in New York) desire to monopolise submarine telegraphy, and as they have put their cable system at something like 50 per cent. premium, probably if they wish to monopolise our lines, they may be prepared to pay something like the same premium for ours. If so I do not know that we should have very much difficulty in dealing with them; but at the same time I am perfectly satisfied that when the one bargain was made there would be another bargain made, probably by other parties, to get their share of the Trans-Atlantic traffic. But what has been the American mode of dealing with telegraphy? The important company there during the last twenty years has absorbed sixty telegraph land line companies, and the monopoly became so apparent that a company was formed to contest this monopoly. Only the other day this company, which was established to contest the monopoly, was bought up, and became the property of the great monopoliser of all. Consequently that company has, I am told, got in these land lines a capital of something like 80,000,000 dollars, for work that could be created for something like one-fourth of that amount. Therefore, their position cannot be a very secure or a very happy one. I am very much deceived in the American character if the enterprise that exists there does not very soon create a system that will enable telegraphic communication in America to be carried on at something like 50 per cent. less than what it is carried on for at the present moment. In making these remarks I have simply had the object of giving you an idea of what is going on just now in America, as well as here. I believe that the companies in whom we are so deeply interested are perfectly able to hold their own, and I see no reason why they should not carry such an amount of the traffic as will maintain the dividends at least which we have hitherto been in the habit of receiving. With these remarks I beg to propose that the report and accounts of the directors for the year ended July 18 ,1881, submitted to this meeting, be and are hereby approved and adopted, and that the following dividends be declared payable this day—3s. a share on the preference shares, making, with the previous dividends, 6 per cent., and 3s. a share on the ordinary shares, making with previous distributions, a total dividend of 4½ per cent., both payable free of income-tax.

Sir DANIEL GOOCH, Bart., M.P.: I beg to second the motion, which was carried unanimously.

Mr. W. Ford and Sir Daniel Gooch, Bart., M.P., were re-elected directors. And Mr. J. G. Griffiths, of Messrs. Deloitte, Dever, and Co., and Mr. W. Griffith were elected auditors. A vote of thanks to the Chairman concluded the business of the meeting.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices August 3.		Business Done Week Ending August 3. Highest.	Lowest.
Anglo-American	51¼,	52¼	51¼	51¼
Do. Preferred	82½,	83½	83½	82½
Do. Deferred	24¼,	25¼	25¼	25
Brazil Submarine	10¾,	⅛	10¾	10¾
Cuba	9⅛,	10	9 11-16	9⅛
Do. Preference	—	—	—	—
Direct Spanish	4¾,	5¼	5 1-16	5 1-16
Do. Preference	13¼,	14⅛	—	—
Direct United States Cable	10¾,	11¼	11	10¾
Eastern Telegraph	10¼,	10⅝	10⅝	10⅛
Do. 6 per Cent. Preference	12¾,	13	13	12¾
Do. 5 per Cent. Debentures, 1899	107,	110	—	—
Eastern Extension	11,	¼	11¼	11
German Union	9⅛,	10¼	10¾	9⅛
Globe Telegraph and Trust Company	6¼,	⅛	6 11-16	6 9-16
Do. Preference	12⅛,	¼	12¼	12¼
Great Northern	13,	⅛	13¼	13¼
Indo-European	28,	29	28¼	28¼
Mediterranean Extension	2¼,	3	—	—
Do. Preference	9,	⅛	—	—
Reuter's	12½,	2¼	12½	12½
Submarine	285,	295	294	294
West India and Panama	1¾,	2	—	—
Do. 1st Preference	7,	⅛	7⅛	7⅛
Western Brazilian	8¼,	⅛	8⅛	-16
West. Union 7 per Cent. 1st Mortgage	125,	130	—	—
Do. 6 per Cent. Sterling Bonds	106,	110	—	—

TRAFFIC RECEIPTS FOR JULY, 1881.

Companies.	July, 1881.	July, 1880.	Increase.	Decrease
Anglo-American Telegraph Company	£46,410	£19,500	£26,910	—
Cuba Submarine Company	2,492	2,915	—	423
Direct Spanish Telegraph Company	1,448	1,423	25	—
Direct United States Cable Company	15,470	6,500	8,970	—
Great Northern Telegraph Company	22,400	—	—	—

THE FIRST ANNUAL MEETING of THE UNITED TELEPHONE COMPANY (Limited) will be held at the CITY TERMINUS HOTEL, CANNON-STREET, on TUESDAY, the 9th inst., at 2 p.m.

The transfer books will be closed from the 1st to the 9th inst. inclusive.

August 3rd, 1881.

EXPOSITION ELECTRIQUE.—An Englishman resident in Paris would be glad to ASSIST an English Firm (as representative or otherwise) at the above. Good linguist. Excellent references, London and Paris. M. K., 70, Avenue du Maine, Montrouge, Paris.

ELECTRICAL and ENGINEERING MANAGER WANTED to take charge of a large Engineering business connected with Electricity. Testimonials will be required as to his capabilities and practical experience. Apply by letter only to W., care of Bates, Hendy, and Co., 37, Walbrook, E.C.

REQUIRED, NUMBER of MEN for laboratory work Men with mechanical aptitude preferred. Address, F.W., care of Steel and Jones, Advertising Agents, Spring Gardens, S.W.

BRITISH ELECTRIC LIGHT COMPANY (Limited).—This Company are desirous of ENGAGING the services of a practical ENGINEER, as works superintendent, having a knowledge of the manufacture and working of electrical apparatus. His duties will be to take charge of the manufacturing establishment of the Company under the direction of the Company's Electrical Engineer, Mr. Radcliffe Ward, to whom apply with terms and testimonials, &c., at the Company's Offices, Heddon-street, Regent-street, London, W.

ELECTRIC LIGHT.

THE ELECTRIC LIGHT and POWER GENERATOR COMPANY are prepared to take orders for either the

INCANDESCENT LIGHT,

30 to 60 candle power (burning in vacuo), for domestic purposes, or the

ARC LIGHT

for Halls, Railway Stations, Streets, &c., &c.

Particulars, Price Lists, &c., by application to

The SECRETARY, 29, BANKSIDE, SOUTHWARK.

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

Southampton-buildings, Chancery-lane

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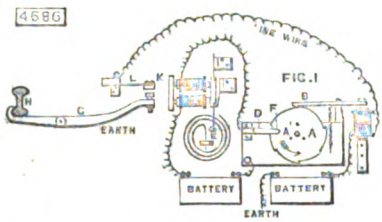
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

4686. Improvements in Signalling on Railways, and Means or Apparatus therefor, *W. W. Biddulph.*—13*th November*, 1880. 6*d*.

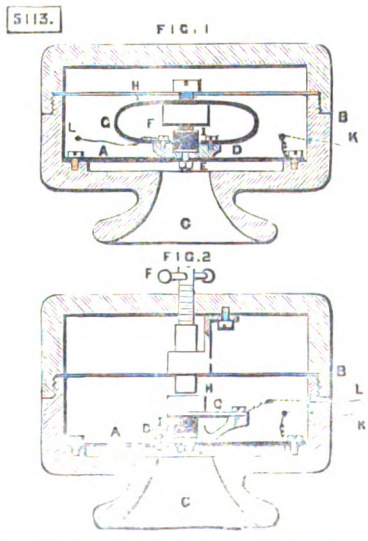
The object of this invention is to afford at each signal box on the line an approximate indication as to the position of any train travelling between such box and the next in either direction. For this purpose the inventor provides an indicator and means for driving and arresting or locking same, so that it may be released temporarily by the train closing or breaking an electric circuit as it passes predetermined points of the line, whereupon the indicator is caused to make a partial rotation, to show that the train has passed the respective part of the line. Supposing a train to have left one station, and be travelling towards A. On moving over the contact point at A, a current is passed through the electro-magnet in the signal boxes at the two stations, *i.e.*, that the train is travelling from and that towards which it



is going. Thus the armatures are momentarily raised, thereby allowing the discs to revolve till brought up by pawls. The depression of the rails caused by the passing of the train is utilised to operate a contact point by acting upon a lever which automatically returns and breaks the circuit after the train has passed. The drawing illustrates the apparatus. A is the disc, divided into segments, controlled by pawl B, and connected with an armature. D is a contact piece pressing against A, and which is in connection with one pole of a local battery. This battery circuit includes a trembling bell. In the back of the disc is a stud, F, of ivory, which rests over and breaks the contact of the spring when the disc is at its starting point. G is the lever connected to earth with short arm in contact with the rail H, the other arm being provided with contact piece corresponding to contact piece K on spring L.

5113. Improvements in Telephones, *J. B. Morgan.*—8*th December*, 1880.—(*A communication from T. A. Edison.*) 6*d*.

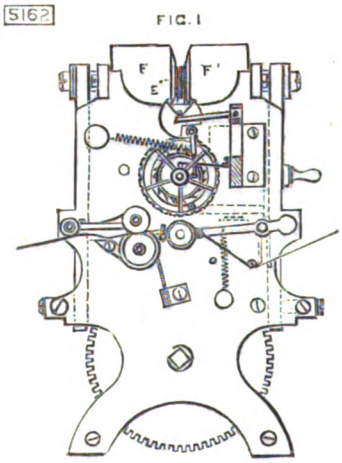
This invention relates to improvements on the



carbon telephone described in patents Nos. 2909 and 2396, and dated the 30th July, 1877, and 15th June, 1878, respectively. The object of the invention is to allow the diaphragm to respond to the atmospheric vibrations without being unduly checked, and at the same time to ensure the necessary pressure and extent of surface contact between the carbon and the electrodes to produce the corresponding electric undulations in the line. In the Figures, the diaphragm is represented at A with a case, B, and mouth-piece, C, the diaphragm A resting on or being secured at its edges to B. The carbon is shown at I; D is a cup of insulating material holding I; E an electrode in the shape of a metal rivet holding D to the diaphragm, the other electrode being a platina disc at the end of screw F passing through spring G connected at its ends to cup D. H is a weight carried by the spring, and one wire K is connected to A, and the other wire L to spring G. The vibrations produced by speech, &c., act upon the atmosphere, and vary the electric condition of the circuit in consequence of H acting by its inertia to vary the pressure on the carbon. In Fig. 2, the screw F is made to act upon a magnet that varies the initial pressure upon the carbon by its proximity to the weight H, which is of iron.

5162. Improvements in Printing Telegraphs, *H. van Hoevenbergh.*—10*th December*, 1880. 1*s*. 2*d*.

This invention relates to improvements in automatic printing telegraphs by means of which the rapidity and certainty of operation of the apparatus is improved, the synchronism between the transmitting cylinder and the type wheel of the receiver is improved by causing the same to be regulated automatically once during each revolution. Fig. 1 shows the receiving apparatus, which is of old construction and form, the improvement which forms the subject of the invention being in an arrangement for producing the vibration of the armature E, by which the step-by-step advance of the type wheel A is produced through the agency of an escapement. Two electro-magnets F and F¹ are arranged with their poles facing towards each other upon opposite sides of E. The yoke of these electro-magnets consists of a permanent steel magnet of horse-shoe shape, into the opposite poles of which N and S (see Fig. 2) the respective cores of the electro-magnets are secured. F and F¹ are preferably arranged with their similar poles facing each other, so that the armature E is attracted



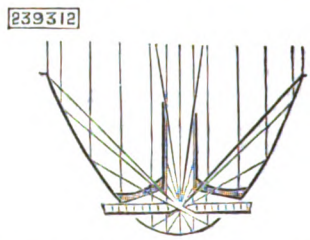
indifferently by either pair of cores when no current is passing. The coils are so arranged that a positive current will generate an electro-magnetism which will reinforce and strengthen the normal magnetism of F, and neutralise that of F¹; E, therefore, will be attracted by F, and not by F¹. The contrary will occur if a negative current be sent. Thus, by transmitting alternate currents, E may be made to vibrate very rapidly. The other improvements relate to the parts of the apparatus which produce the impression of the proper letter on the paper, and moves it forward as required, and the synchronism of the type wheel with the transmitting apparatus at the distant station. Fig. 2 shows the general arrangement of the circuits and mechanism, T and T¹ being the binding screws for the attachment of the line wires. The normal circuit through the instrument is from T by wire 1 to electro-magnet F; thence by wire 2 to F¹; thence by wires 3, 4, and 5 to printing magnet K; thence by wire 6 to T¹. The shunt circuit, which cuts out K, starts from the point 4 between the type wheel magnets F F¹, and the printing magnet K, and goes through the frame of the instrument to the kerb of the type wheel A, and thence through contact point R, spring S (when the latter is in contact), and wire 8 to binding post T¹, where it rejoins the main wire. The three principal working parts of the apparatus are operated by three different strengths of current, the normal strength of current, which is also the weakest, is sufficient to actuate the escapement, controlling the type wheel by reversals of polarity, but not sufficient to withdraw the unison stop L. A certain additional strength is sufficient to effect the printing also, but not to withdraw the unison stop, which can only be done by the aid of a still stronger current, and this last is prevented from operating the printing magnet by the shunt device abovementioned. The latter part of the specification of this patent refers to the transmitting apparatus.

5275. Electric Lighting, &c., *D. G. FitzGerald.*—16*th December*, 1880.—(*Not proceeded with*). 2*d*.

The carbons used have any degree of hardness imparted to them by treating them with solutions rich in carbon, also with salts of the refractory metals, and with salts such as those of magnesium and cadmium, which, when decomposed, furnish an infusible earth or oxide. To facilitate perfect contact with the carbon, the terminals are coated with any suitable metal. It is preferred to enclose the carbon in a glass vessel filled with acetylene, cyanogen, olefiant gas or vapour of mineral naphtha.

239,312. Reflector, *C. F. Brush, Cleveland, Ohio.*—*Filed August 6th*, 1880.

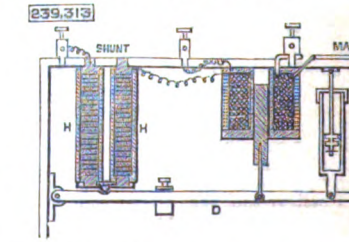
Claim.—The combination with a concave reflector, of a cut-off tube, having a non-reflecting inner surface, said tube located in such proximity



to the light or frame as to intercept and cut off the direct rays of light, substantially as shown and described.

239,313. Current Governor for Dynamo-Electric Machines, *C. F. Brush, Cleveland, Ohio.*—*Filed May 26th*, 1880.

Claim.—(1). In a current governor constructed to operate in connection with a dynamo-electric machine, an electro-magnet excited by two helices, on helix included within the main circuit, and the other within a shunt circuit, within which said shunt circuit is placed an adjustable resistance, substantially as shown. (2). The combination, in an electric current governor, of an adjustable or variable resist-



ance, mechanism to vary said resistance, substantially as specified, and a dash pot an equivalent for modifying the motion of said resistance-varying mechanism, substantially as shown. (3) In a current governor constructed to operate in connection with a dynamo-electric machine, as shown, a dash pot or any equivalent device or mechanism that shall interpose a retarding influence or action in one direction only, substantially as shown. (4) In a current governor constructed to operate in connection with a dynamo-electric machine, an arm or lever, D, in combination, first, with an adjustable resistance con-

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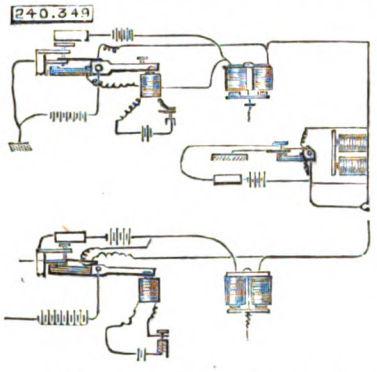
structed to be varied through the movement of said lever; second, with an electro-magnet, through the influence of which motion is imparted to said arm or lever; and third, with any suitable mechanism (such as the dash pot or its equivalent) for governing or modifying the movements, substantially as shown. (5) In a current governor constructed to operate in connection with a dynamo-electric machine, two or more resistance piles, H, or their equivalents, electrically connected in series, and a device associated with each pile for varying its electrical resistance, substantially as shown.

240,349. DUPLEX TELEGRAPH, *John C. Wilson, Boston, Mass.—Filed January 5th*, 1881.

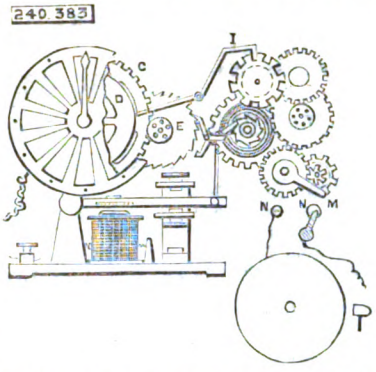
Brief.—A system in which the equating batteries nullify the effects of the distant main batteries on the home relays, so that when both keys are down the home instruments work by their local or equating batteries, and when either key is closed singly the distant relay works by its respective main battery, the home main battery being cut out while the home equating battery is cut in. *Claim.*—(1) That improvement in the art of duplex telegraphy which consists in maintaining a relay unaffected by the currents transmitted from the same station therewith for signalling a distant station, as hereinbefore described, by closing an independent local battery circuit through the said relay when the main battery current is removed therefrom, and opening the said local circuit when the main battery current is thrown on, the said local current being equivalent to the main current in its effect on the relay at that station, but having no appreciable effect on other relays in the main circuit, substantially as and for the purpose described. (2) In a duplex telegraph system, the main battery and line and relay therein, and a local battery and circuit passing through the said relay and adjusted to produce an effect upon the said



relay substantially equal and of the same character with that of the main battery, combined with a transmitting instrument provided with closing points arranged to close the local circuit in the movement by which the main battery at the home station is removed from the line, and open the said local circuit by the movement that puts the main home battery to line, substantially as and for the purpose described. (3). In a duplex telegraph system, the main battery and its circuit and relay therein, and the local circuit joining the said main circuit on either side of the said relay, the coils of which are thus common to both the said circuits, and a battery and rheostat in the said local circuit, whereby its effect on the relay is made substantially the same as that of the main battery, and the impulses from a distant station are confined mainly to the said relay, combined with a suitable circuit-controller to close the said local circuit only when the main battery at the same station is removed from the line, whereby a current from a distant station will produce the same effect upon the said relay, whether it is under the additional influence of the current from the main or local battery at its own station, substantially as and for the purpose set forth.

240,383. TELEPHONE CALL BELL OR ALARM, *George A. Cardwell and Nelson L. North, Brooklyn, N.Y.—Filed November 13th*, 1880.

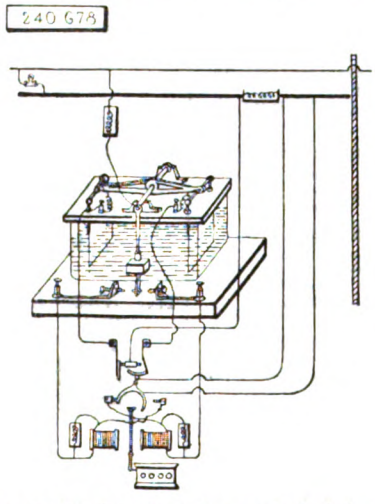
Brief.—A local circuit containing a bell is closed by means of a revolving lever carried by clockwork, the said clockwork being controlled by an electro-magnet. *Claim.*—(1) The combination of the great wheel C, pinion E, pin-wheel D, pivoted lever I, contact lever M, and contacts N with a train of clockwork, substantially as described, a local electro-magnetic alarm, controlled through the medium of said clockwork, and an electro-magnetic detent, through which the clockwork is controlled, substantially as and for the purpose set forth. (2) In a telephonic or telegraphic call or alarm, the combination with the clockwork



mechanism under electro-magnetic control, substantially as described, of the local electro-magnetic call or alarm, the contacts N N and the contact lever M, substantially as and for the purpose set forth.

240,678. WEBERMETER, *Thomas A. Edison, Menlo Park, N.J.—Filed October 7th*, 1880.

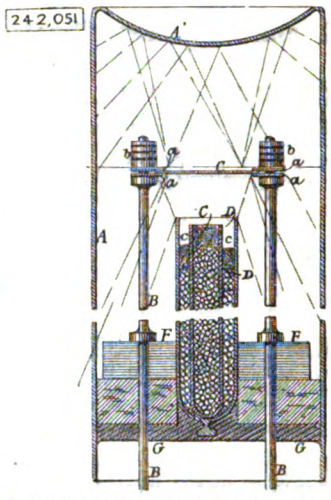
Brief.—In a cell containing copper or other metal in solution is placed a pair of balanced depositing plates. A proportional derived current is passed through the cell from one slate to the other until one becomes sufficiently loaded to move an arm connected with the balance lever, so as to effect a reversal of the current whereby the loaded plate is freed from its burden and metal deposited upon the other with a like result. A registry apparatus records each movement of the reversing mechanism, thereby indicating the amount of electricity employed. *Claim.*—(1) In an electro-depositing cell, the combination, with the plates therein, of means for changing the anode and cathode relation of the plates, substantially as set forth. (2) The combination of a decomposing cell, balanced polar plates therein,



and a registering apparatus controlled by the overloading of either plate, substantially as set forth. (3) The combination of a decomposing cell, balanced polar plates therein, and a reverser reversing the direction of the current through the cell, and controlled by the overloading of either plate, substantially as set forth. (4) The combination of a decomposing cell, balanced polar plates therein, and registering apparatus, and means for reversing the direction of the current through the cell, the register and reverser being controlled by the overloading of either plate, substantially as set forth. (5) The combination with a main circuit, of a shunt or branch circuit through which passes a definite portion of the current, a depositing cell containing balanced plates, a register, and a reversing apparatus, substantially as set forth.

242,051. ELECTRIC LAMP, *Fritz Salathé, John E. Brustlein, and Paul Surey, New York, N.Y. —Filed March 5th*, 1880.

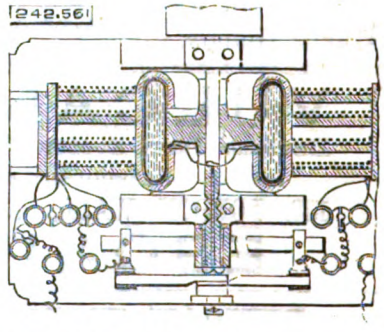
Claim.—(1) The combination, in an electric lamp, of a transparent shell or globe, two metallic rod conductors arranged therein, a carbon ring forming the light-giving portion, and carbon clamps holding the carbon ring between them fitting upon the metallic rod conductors, and screw nuts for tightening said clamps upon said rods, substantially as and for the purpose specified. (2) The combination, in an electric light, of a closed transparent shell or globe, a carbon or other light-giving device arranged therein, and two vases or vessels, one containing a chemical or chemicals for absorbing oxygen and the other a



substance for absorbing nitrogen, placed one within the other, and arranged in the shell or globe substantially as specified. (3) The combination in an electric lamp of a closed transparent shell or globe, a carbon or other light-giving device arranged therein, and a vase or vessel for holding a chemical, also arranged in said shell or globe, and having a silvered surface, whereby it is made to constitute a reflector, substantially as and for the purpose specified.

242,561. DYNAMO-ELECTRIC MACHINES, *Henry C. Sample and Franz Rabl, Philadelphia, Pa.—Filed February 21st*, 1881.

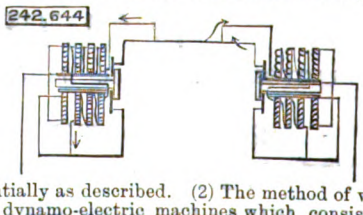
Brief.—The field magnets are formed of tubular cores, one enclosed within the other, with pole pieces nearly enclosing the armature. The armature core is formed of alternate layers of wire



gauze and perforated sheet metal. The field magnets may be connected in quantity or tension by means of suitable plates and connecting plugs. The commutator brushes are independently carried upon adjustable arms.

242,644. DYNAMO-ELECTRIC MACHINE, *Paget Higgs, New York, N.Y.—Filed March 3rd*, 1881.

Claim.—(1) A dynamo-electric machine, in which the cores of some of the field-of-force magnets are placed in the shunt circuit only and the rest of the cores are in the main circuit, sub-



stantially as described. (2) The method of working dynamo-electric machines which consists in magnetising a part of the field-of-force magnets by the main current and a part of them by the current of a shunt circuit, substantially as described.

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ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians, 86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.
Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manu-facturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

VULCANITE.

HARBURG INDIA-RUBBER COMB COMPANY.
LONDON WAREHOUSE: F. WINTER.
138, LONDON WALL, WOOD ST., E.C.

EBONITE.

DUNCAN WALLET & CO.,

BONDED STORE AND PROVISION MERCHANTS,

15, BILLITER STREET, LONDON.

Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

JOHNSON'S TRANSMITTER

(PATENT).

LOUD AND CLEAR. NO JARRING.
PERMANENT ADJUSTMENT.
NO OXIDATION. ONE LOCAL CELL.

TASKER, SONS & CO.,

ELECTRIC AND TELEPHONIC ENGINEERS,
SHEFFIELD.

ELECTRIC LIGHT.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

TELEPHONE TRAINING SCHOOL, BEULAH-HILL, UPPER NORWOOD.—Under influential patronage.—A complete COURSE of PRACTICAL and SCIENTIFIC INSTRUCTION, with a view to future appointments.—For particulars, address THE PRINCIPAL, Telephone Training School, Beulah Hill, Upper Norwood.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,

76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.

Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.

Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.

NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

FERD. CAPITAINE, Civil Engineer, 178, BOULEVARD VOLTAIRE, Paris.

Special attention given to every branch of applied electricity. Patents of Inventions applied for and worked on the Continent. Companies formed. Representation at Exhibitions. Commission Agent.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

WALTER T. GLOVER and CO.,

CONTRACTORS TO H.M. POSTMASTER-GENERAL, THE INDIAN GOVERNMENT, THE PRINCIPAL RAILWAY TELEPHONE, AND ELECTRIC LIGHT COMPANIES.

25, BOOTH STREET, MANCHESTER. Works: SALFORD.

INSULATED ELECTRICAL WIRE MANUFACTURER.

Manufacturers (by patented processes) of Patent Covered Gutta Percha Wire, Covered Iron Wire, Fancy Telephone Wire and Terminal Cords, Silk and Cotton Covered Wires, Special Electric Light Leads, &c.

ALL CLASSES OF AERIAL AND UNDERGROUND CABLES, AND SPECIAL ANTI-INDUCTION CABLES FOR THE TELEPHONE.

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SLIP

CABLE REPAIRED.—The Eastern Telegraph Company notify the repair of their Aden-Bombay cable, which is now in good working order.

SOUTH AFRICA.—The rate for telegrams to the Orange River Free State by the Eastern Telegraph Company on and after the 15th inst. will be 9s. 1d. per word.

EASTERN TELEGRAPH COMPANY.—The traffic receipts of this company for the month of July, 1881, amounted to £38,171, and to £43,352 in the corresponding period of 1880.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this company for the week ended the 29th of July amounted to £2,909, and for the week ended the 5th August to £3,127.

ALGERIA.—Telegraphic communication here is still uncertain. News of the 3rd of August stated that the wires were cut for a considerable distance between the Medjez-el-Bab Railway Station and Kef.

THE TELEPHONE IN THE NORTH OF ENGLAND.—The telephone seems to be gaining favour in the north every day, applications to local authorities for leave to erect telephone lines being very numerous.

ELECTRIC LIGHT FOR DURHAM.—At the last meeting of the Urban Sanitary Authority of this town the question of lighting portions of the town by electricity was referred to a committee to report upon.

ERRATUM.—In Fig. 1, illustrating the letter on secondary batteries in our last issue, p. 185, the right-hand key should be marked k_1; and in Fig. 2 the middle vertical line should be lettered k_1 d d_1 instead of k d d.

ELECTRIC LIGHT AT KING'S CROSS STATION.—Mr. Crompton has successfully installed his system of lighting by electricity at this station of the Great Northern Railway. We hope to give some details in a future number.

TELEGRAPHS ON THE HIGH ROAD.—The Tottenham Local Board have unanimously refused their sanction to an application from the Post Office for permission to erect telegraph poles along certain portions of the Enfield high road.

TELEGRAPH STAMPS.—The Postmaster-General, replying to a letter addressed to him, says that the question of abolishing telegraph stamps has been for some time under his consideration, but he has not been able yet to come to a decision.

ORIENTAL TELEPHONE COMPANY.—The Board of this Company have received the following message from Alexandria, Egypt, dated 9th inst.:—"Telephone exchange opened yesterday. Subscribers now talking. Working satisfactorily."

EASTERN EXTENSION TELEGRAPH COMPANY.—The traffic receipts of the Eastern Extension, Australasia, and China Telegraph Company for the month of July amounted to £31,751, and to £32,194 for the corresponding period of 1880.

WEST INDIA AND PANAMA TELEGRAPH COMPANY.—The estimated traffic receipts of this company for the half month ended July 31 amounted to £2,000, as compared with £1,786 in the corresponding period of 1880. The April receipts, estimated at £5,470, realised £5,586.

ELECTRIC LIGHT V. GAS.—At a recent meeting of the Dundee Gas Commission, it was stated that several large consumers in the town were fitting up their premises for the electric light, and that if it were found to be satisfactory its adoption would affect the gas revenue.

OVERHEAD WIRES AND LOCAL AUTHORITIES.—At the last meeting of the St. Saviour's District Board of Works, the General Purposes Committee reported that they had considered the question of overhead telegraph wires, and were of opinion that the board was exempt from all liability by section 42 of the Act of 1863.

SS. "GREAT EASTERN."—This vessel, which has been so intimately connected with Atlantic cable work, is to be sold by Messrs. C. W. Kellock and Co., Admiralty brokers, on the 19th of October next. She is still lying at Milford Haven, where she has lain idle for a long time.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this Company for the week ending the 5th of August, 1881, amounted to £2,010, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

ACCIDENT BY LIGHTNING.—A Reuter's telegram, dated New York, the 7th of August, says a party of labourers in South Carolina were struck yesterday while at work by lightning, which killed four of the men on the spot and injured twelve others, five of whom are not expected to live.

PRICES.—The prices as quoted are:—For gutta percha per lb., genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber, per lb., fine Para, 3s. 5d.; negrohead, 2s. 1d. central American, 1s. 7d. to 2s. 3d.; Assam and Pegu, 9d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 4d. to 2s. 2d.

TELEGRAPH CLERKS' GRIEVANCES.—A deputation of telegraph clerks, from Manchester, Leeds, Bristol, &c., waited upon Mr. Macliver, M.P., on Monday evening at the Hou of Commons, in reference to his efforts to induce the Postmaster-General to reconsider his scheme for redressing the grievances of the clerks, and also in favour of the claims of the letter carriers.

INTERNATIONAL MEDICAL CONGRESS.—In the early part of this week a visit was paid by the members of this Congress (recently held in London) to the works of Messrs. Siemens Brothers, at Woolwich. About three hundred gentlemen went over the works and the cable ship "Faraday," where they saw how the cables are made, shipped, stowed away, and paid out.

THE STORAGE OF ELECTRICITY.—The Cleveland (U.S.A.) *Trade Review* says that Mr. C. Brush, of electric light notoriety, has invented a system of electric storage for lighting purposes. All that is yet known of the system is that metal is used as the recipient of the electricity to be stored. Mr. Brush has stated that he is able to store double as much electricity as M. Faure in a given space.

ELECTRIC LIGHT AT COVENT GARDEN CONCERTS.—Amongst the improvements that have been effected at the Covent Garden Theatre is the introduction of the electric light. The theatre is illuminated by Brush lights and gas combined, and the Floral Hall, which is used as a smoking lounge, is lighted solely by electricity. It is stated that the effect of this is to keep the atmosphere far cooler than with gas.

ELECTRIC LIGHT ON BOARD SHIP.—In our note of last week, saying that the Cunard Company were fitting up their steamship "Servia" with Swan lamps, we stated in error that "the requisite current will be obtained from a Brush dynamo-electric machine." The lights will be driven by one of Messrs. Siemens's large size dynamo machines (W.1), which are capable of feeding 240 lamps, and not by a Brush machine.

THE ELECTRIC LIGHT AT COCKERMOUTH.—The Cockermouth Local Board have accepted a tender for lighting the principal streets by means of the Brush electric light. The back streets, which are narrow and crooked, and which could

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not economically be lit by means of the electric light, are to be lighted with the "Orion" patent gas-oil lamps. The board have thus entirely dispensed with the use of gas. The contract is for three years, and is for a smaller sum than was previously paid for gas.

ELECTRIC LIGHT AT BRIGHTON.—Experiments have been recently carried out at Brighton by Mr. Easton, consulting engineer to the Town Council, with the object of ascertaining how electricity can be employed in lighting small streets which do not require an overpowering amount of light, and also to effect this illumination so as to compete advantageously with gas. The experiments were made with some of André's lamps of about 25 candle-power each, placed at short intervals of about 48 yards. The results are said to have been satisfactory.

ELECTRIC LIGHTING IN DUBLIN.—The Corporation of this city, who, it will be remembered, recently refused the application of the Dublin Gas Company for leave to light part of the city by electricity at their own expense, have been applied to by the Dublin Electric Light Company, which has only recently been started, for permission to lay wires under the footways for the purpose of lighting certain streets with the Brush lamp. The matter has been referred to a committee, who, in turn, have taken counsel's opinion as to the power of the Corporation to give permission to the company to break up the roads.

REGULATING ELECTRIC LIGHT CURRENTS.—According to the *Dundee Advertiser*, Mr. Joshua Horton, electrical engineer at Messrs. Denny and Co.'s Engine Works, Dumbarton, has devised a means by which "he is able to adapt the electric current exactly to the amount of lighting that may be wanted within the limits of the current-generating machine. Whether fewer or more lights are wanted, the power developed is always in accordance therewith, and in consequence 'coils,' and all other forms of 'resistance' appliances are rendered unnecessary." As patent rights may be applied for, no details are given of this device.

THE POSTAL TELEGRAPHISTS.—It is commonly rumoured that the Post Office is losing "all its best hands" through the recent misunderstandings, and the dissatisfaction created by the Treasury minute. Probably this is an exaggeration; but we believe it is the fact that from many of the large offices, including the central station in London, a considerable exodus of skilled telegraphists is taking place. The new Atlantic Company, it is stated, is absorbing some of these, whilst some of the other submarine cable companies are finding remunerative openings for the rest. This is a very acceptable windfall for the companies in question, and perhaps also for the operators; but it is not an encouraging outlook for the Postal Telegraph Administration.

CABLE TO SHETLAND.—In the House of Commons this week, Mr. Laing asked the Secretary to the Treasury whether it was the fact that, owing to the interruption of the postal telegraph to Shetland from the delay in procuring a repairing ship, storm warnings cannot be conveyed there by telegraph, which might often, and especially on the occasion of the late disastrous gales, be the means of saving the lives of many of the poor fishermen; and whether, in view of this lamentable occurrence, the Treasury would at once sanction the acquisition by the Post Office of a suitable repairing ship to maintain those telegraphic cables to Orkney, Shetland, the Lewis, and other islands of her Majesty's dominions. Lord F. Cavendish said the Government were considering the subject.

THE TELEPHONE AT OLDHAM.—Last week we noticed that *The Times* was connected by telephone with the House of Parliament, and that the speeches of members were transmitted thereby to Printing House-square, at a great saving of time and labour. A provincial paper, the Oldham *Evening Express*, has also adopted the same means of communication between Manchester and its offices in Oldham, and now appears with its items of news headed "Special Telephonic Despatch." The line, which is twelve miles long, was erected by Messrs. David Moseley and Sons, of Manchester, under the superintendence of their engineer, Mr. W. F. Bottomley. The transmitter used is one of Messrs. Moseley's own manufacture, which is said to be very clear and distinct, and free from induction noises.

ELECTRIC BREAKS FOR TRAINS.—M. Achard's system of electric breaks is being tried on the Eastern Railway in France. In this system electrical connection is established between the axles of each carriage and a drum, on which is wound a chain, which acts on the brake levers. This drum forms an electro-magnet. Two springs keep it away from the axle of the carriage, and also act as conductors of the current when it is applied. When the current is turned on each magnet is attracted to the corresponding axle, which at once transmits its motion to the magnet, the chain on the latter is wound up, and the brake levers applied. It is said that the train can be brought up within a distance of 150 to 200 metres, when going fifty miles an hour, and that in 1 6-10ths of a second from the time the current was first applied, all the wheels of the train can be skidded.

A PORTABLE TELEPHONIC APPARATUS.—A certain M. P. Dhamelincourt, of Hendebouville, France, makes use of a portable telephone apparatus, with which he directs works at a distance on his farm, thus saving the time and trouble necessary for a personal visit. His plan is simply to have a tripod carrying a movable roller, on which is wound a conducting cable composed of two insulated wires. Below this on a movable board is a small box, in which is placed a telephone and bell. The system allows the current to pass from the bell to the telephone without using a commutator. Thus, the telephone being at rest, the bell is in connection with the line, and when the telephone is in use the bell is cut out of the circuit. Another telephone and bell are fixed in the house of the farmer, with a commutator. M. Dhamelincourt has tried this system and found it to answer.

ELECTRIC LIGHTING AT THE GUILDHALL.—Last week the Lord Mayor gave a *conversazione* at the Guildhall to the members of the International Medical Congress, upon which occasion there was a large display of the different systems of electric lighting. Messrs. Siemens Bros. had three of their large lights in the Guildhall, and four in the reception tent. They also lit the Aldermen's council room with two rings of Swan lights, twenty-five lamps on each ring. In the corridors each gas light was replaced by a Swan lamp. In another room they had one large light placed in a dome in the centre of the room, and rings of twenty Swan lamps each in the four corners of the room. The big light was shaded by a yellow tinted glass in order to assimilate its light to that of the Swan lamps. In all there were 160 Swan incandescent lights exhibited. The same machine that drove these lights also drove the big lights in the reception tent. Two engines of 8 horse-power each were used, and the display was very successful. The Faure battery was shown, and fed twenty-four Maxim incandescent lamps, which were used to light up the staircase.

INSTITUTION OF MECHANICAL ENGINEERS.—In his inaugural address at the meeting of this institution, held last week at Newcastle-on-Tyne, Mr. E. A. Cowper, the president, made the following remarks with reference to electricity;—

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"The electric light has made such numerous and rapid strides that it is impossible even to notice its various applications; but, on the one hand, the lighting by Dr. Siemens of four miles of dock frontage at the Albert Dock of the London and St. Katherine's Dock Company, together with the railway behind the warehouses, and the warehouses and ships themselves, and, on the other hand, the elegant and steady domestic light of Mr. Swan, are excellent examples of the two extremes in this department. I believe we shall have the pleasure of closely observing the Swan light during our visit here. The lighthouse electric light is also a noble application of the great power of a single electric light on the arc principle. The most powerful electric light in the world is situated near here, on the coast between the Tyne and the Wear. It is possible, and even probable, that one of the great uses to which electric force will be applied eventually will be the simple conveyance of power by means of large wires; and as a higher percentage of power is gradually being realised this method will become more economical. I may mention that 60 per cent. has already been obtained."

Enterprising Journalism.—Some surprise has been felt at the descriptive reports which have appeared for some weeks past of exhibits that *were* to be displayed at the Paris Exhibition. The *Standard* of Tuesday outdoes its contemporary by describing apparatus that has not yet even arrived on the scene. This is the strain in which it speaks of the Edison section as it is going to be:—"The Edison display will be, however, far more interesting when his large combined boiler of one hundred and fifty horse-power steam-engine and generator all on one bed plate has arrived. The seven hundred lamps which he has put upon the Grand Escalier will then be lit, and the whole of his lamps in the Palace will be driven from it as one complete district. Besides this, connection will be made with five hundred lamps in the restaurant, which will be also worked by this powerful machine. In one of the external gardens five hundred other lamps will be connected, and yet again five hundred more in a theatre two thousand feet across the Champs Elysées. Of the details of this combined machine we may say that its total weight is seventeen tons complete, of which the magnets weigh six to seven tons, and the armature, which will make three hundred and fifty revolutions per minute, will weigh two and a half tons. Its capacity of illuminating power is equal to," &c., &c., &c. After this it is really of no consequence whether Mr. Edison's shipment comes to hand or not.

Electric Lighting in Mines.—The installation of the Swan incandescent light in Earnock Colliery, near Hamilton, in Scotland, has been accomplished, and on the 9th instant several gentlemen visited the pit to see the light in operation. The lights are worked by a Gramme machine of the A type, driven by a machine which is also used for driving sawing machinery. The dynamo-machine is placed at a distance of 260 yards from the head of the pit shaft, the current being conducted over this distance by a bare copper rope $\frac{3}{8}$ths of an inch in diameter, carried on poles and insulated at the supports by a combination of porcelain cups and vulcanised india rubber. The conductor down the shaft consists of 19 No. 22 B.W.G. copper wires, insulated with gutta percha, taped and tarred, and enclosed in a galvanised iron half-inch tube. This cable is also used in the workings, where it is carried partly in wooden uprights and partly beneath the surface. The number of lamps at present installed is 16 fixed and six portable, which are spread over about two miles of wire, reckoning the return circuit. The fixed lamps are suspended from the roofs of the workings, and are enclosed in strong glass globes, fitted with convex reflectors of silvered copper. The portable lamps are attached to long flexible cables, so as to be capable of being used at the face of the coal. They can be hung in any position, and are enclosed in strong glass lanterns, these again being protected by stout wire guards. The switches and contact makers throughout are constructed as for a fiery mine, and are made quite air-tight, in order to prevent the communication of a spark to the atmosphere of the mine. To show the steadiness of the light, some gunpowder was blasted without having any effect on the lamps. The visitors were also photographed in the mine by the aid of the light. The installation was carried out by Messrs. D. and G. Graham, of Glasgow, the engineer being Mr. A. R. Bennett.

The Induction Balance and Surgery.—With reference to our note of last week (*The Electrician*, Vol. VII., No. 12) on this subject, we reprint a telegram from the Paris correspondent of the *Standard*, which is of interest. He says:—"The determination of the position of the bullet in the person of President Garfield is another instance of the capability as well as the perfection of modern science. It has been accomplished by a very ingenious, at the same time simple, application of the induction balance of Professor Hughes and the Bell telephone. If two coils be put at some little distance apart, and to one of the two wires connecting them there be attached a telephone, and if near to these is placed another pair of coils, in one of the connecting wires of which there be inserted a rheotone for making a musical intermittent current, and this lower pair of coils be connected to a battery, there will be a continuous note heard in the telephone. If one of these coils be inverted, or the connecting wires be crossed, there will be currents passing from each pair of coils in opposite directions. So soon, however, as the force of each current is adjusted, which can be done by a screw attached to one terminal set of the coils, whereby their relative position in regard to each other can be altered, the note will cease, and silence will be obtained. This condition of equal tension constitutes the induction balance. If now an extraneous piece of metal be brought near to either set of terminal coils induction will be again set up, and the note will be heard in the telephone. The application to surgical purposes consists in securing one set of terminal coils together with an insulating plate between them, and connecting this set by long wires to the rest of the instrument. This couple can then be moved freely over the person of the patient, and as it approaches the seat of the bullet in the wounds the equality of the opposing currents of the induction balance is disturbed, and the signifying note goes on in the telephone, and continues to increase up to the nearest possible contiguity between the couple and the bullet. The intervening distance, or thickness of flesh, can then be measured off on a mechanical scale of the varying intensities of the telephone note. This intervening distance can be further checked by taking a corresponding bullet and operating with it upon the other or fixed couple of terminal coils. As the duplicate bullet approaches the upper of these coils its inductive action becomes the greater, and starting from zero as it comes within the radius of induction, its increasing influence gradually matches the disturbance of the bullet upon the free couple, and the note in the telephone ceases. Another basis of measurement is thus found. If the two masses of metal were unequal in bulk, or different in weight or kind, the estimation of the distance of the one could still be made by calculation, so that unknown conditions can be resolved if needful."

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THE ELECTRICAL EXHIBITION AT PARIS.

Before commencing our report of this Exhibition, we wish to put on record an emphatic protest against the tendency shown by some of our excellent contemporaries (and, in this particular case, our contemporary *Engineering*) in publishing reports of exhibitions before they are really opened. We hold that a report should not be published till the apparatus has been seen by the reporter *in situ*, instead of being, perhaps, as yet in another country. Accidents might occur to prevent the apparatus specially reported upon appearing among the exhibits at all. In making these remarks we do not so much consider our own position and interests as what is due to readers. The reporter is supposed to have seen the things he describes at the place they are to be exhibited, but if reports are to commence three weeks before the opening day, why not three months, at a time when it is inconceivable that any reporter could see them in position. There is a limit to newspaper enterprise in certain directions, and it behoves papers that have a character to sustain to be careful in breaking through a certain undefined but well-understood code. The moment the exhibition opens give your report as fully and as freely as possible. Let the report describe not *what is to be*, but *what is*—the actualities of the case and not the probabilities.

The value of an exhibition is in the opportunities it gives for comparison. Enterprise is shown by being first in the field, but is it enterprise to describe what is not in the field, or what is still in packing cases? You may desire to point a moral and indicate the slow movements of your contemporaries, but, if the practice we refer to is to continue, the result will be that some paper will next time commence four, five, or six weeks before the probable time of exhibition, and then another may try to gain priority through the anticipation of events by eight or ten weeks. A nice spectacle certainly—an indication of enterprise undoubtedly, but whether commendable or not, is another question. Having recorded our protest against such a course of action, we leave to our reporter the more agreeable task of describing what is in the Exhibition.

(FROM OUR SPECIAL CORRESPONDENT.)

PARIS, WEDNESDAY NIGHT.

The Exhibition was duly inaugurated this day in the presence of the President of the French Republic, and a distinguished company. The exhibits are, however, for the most part backward, Messrs. Elliotts, Siemens, and Apps, being the chief firms whose work is at all complete. My report, therefore, is necessarily confined for the present to the

ELECTRIC LIGHT MACHINERY.

It was the enterprise of Paris, and the excellence of the Jablochkoff lamp as compared with gas, which a couple of years ago brought into prominence the many good properties of the electric light for general illuminating purposes. Visitors to Paris having seen the electric light in the streets around the Opera House carried away an impression of its grandeur that was perhaps exaggerated, but which was, nevertheless, the means of directing the attention of every civilised nation to its properties.

The non-technical papers, totally ignorant of the scientific aspects of the case, introduced into the popular mind ideas altogether erroneous, yet so abiding that they still exist. The divisibility of the electric light is what the ninety and nine say the inventors are endeavouring to find, and think that, to a certain extent, success has been achieved. It is impossible to drive away the illusion and to enforce the doctrine that in this direction nothing new has been or is likely to be done. Mathematicians knew years ago as much about resistances, lamps in "series," or in "multiple arc," as they know now. It was not in this direction that science was working at all. The men who have developed the properties of electric lighting are those who have worked at the perfecting of the steam-engine as a motor for the dynamo-machine, who have improved the dynamo and magneto machines, so that the current is more economically generated, who have experimented in every direction, and added minor improvement after improvement to the arc and incandescent lamps—these are the men who have made electric lighting not only practicable, not only possible, but, almost certainly, the light of the immediate future. It is absurd for the gas companies to continue as they do at their meetings to speak of electric lighting as unpractical, to talk of oil as a competitor in lighting more to be feared than electricity. They should preferably gird up their loins, and seek new fields for gas.

At the time of the Paris International Exhibition, the electric light was unknown to the English public; its use at one or two lighthouses was looked upon as an expensive experiment, but now it is installed in scores of places. It is met with in shops, in factories, in streets, in docks, in public buildings, and in private houses. Every meeting, *conversazione*, or even flower show of repute, is thought to be imperfect without the electric light. The railways are adopting it in all their principal stations, the steamship companies are introducing it into their ships, and so on. Comparison of the now with the then shows most conclusively that the progress made is by no means of a character to be despised, and we may without fear say that future progress is likely to be still more rapid.

The introduction and the progress of the electric light is as much the question of to-day as the introduction and progress of gas was some fifty or sixty years ago.

The exhibits relating to electric lighting naturally divide themselves into three classes:—

(1) Steam or gas engines to be used as motors.

(2) Dynamo and magneto machines to be used for generating the electric current.

(3) Electric lamps.

The third class is again divisible into:—

(α). Lamps on the arc system.

(β). Lamps on the incandescent system.

It will, perhaps, be necessary in our report, to say many things which have been said before, to describe apparatus which is not new, and which has been previously described; but we must ask those to whom these things are as "familiar as household words" to remember that the world is moving on, that boys are growing into men, that learners to whom all is new, are constantly entering the field, and that the avoidance of everything that is not novel would leave them almost as ignorant as if they never read a line. This Exhibition should lead many people who have hitherto looked upon electrical matters at a distance to become better acquainted with them, and others who have already made a commencement to a closer investigation and a deeper knowledge of the science.

Keeping the classes of apparatus in mind, it will not be necessary to deal wholly with one class at a time. The work would be monotonous, and we fear uninteresting.

One of the first questions that a constructor of steam engines would ask would be, what are the peculiarities in the work you want the engine to do? and the electrician would then explain that as yet his apparatus was imperfect, and that, as far as possible, the results of imperfections should be remedied. In the arc system, for example, the resistance of the circuit is variable, and to get a perfectly steady light it is necessary to counteract the effect of this variation. If the resistance increases the electromotive force should increase correspondingly; if it decreases there should be a corresponding diminution of force. Now, the current depends upon the number of revolutions per minute of the armature, providing the magnetic field of force through which the armature revolves and the resistance of the circuit is constant. The change of circuit resistance is generally caused by the action of the lamp; this influences the current from the armature, and the compensation must come (as the work is done at present) from the increase or diminution of revolutions of the armature. The armature is revolved by direct acting fast speed engines, or by engines through intermediate gear.

A perfect system would be one in which the engine, as it were, foretells the change in resistance, and shuts off or puts on steam accordingly. No person has introduced such an engine, or is likely so to do. The next best plan is to arrange for compensation as soon as possible after the change in the circuit takes place. The builders of steam engines, with these facts before them, have aimed at giving engines built for electric light purposes a very delicate governing arrange-

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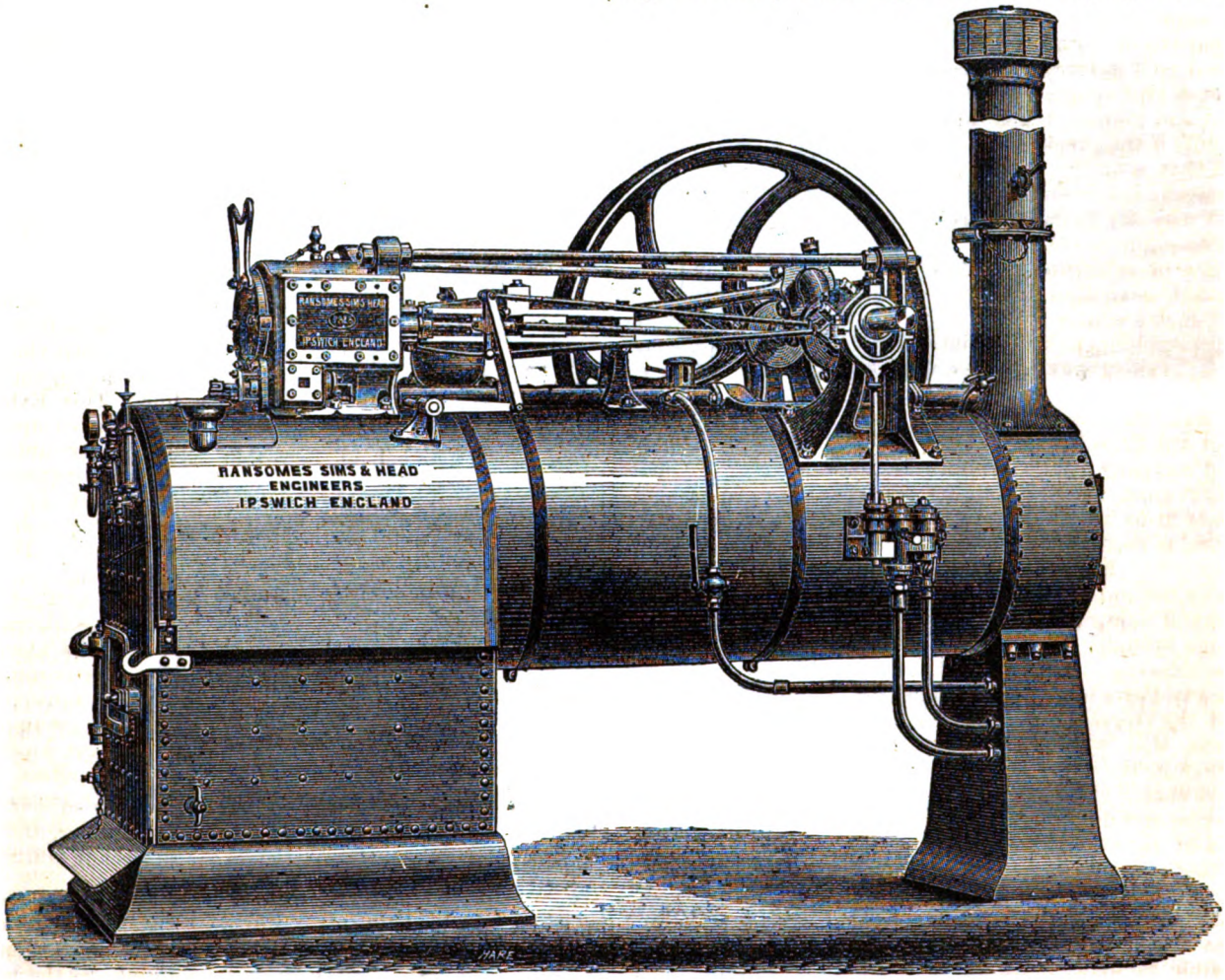
ment, so that though the action of the engine is not exactly at the same point of time as the alteration of resistance, it takes place within an exceedingly short period afterwards.

The investigation, therefore, of the merits of an engine for electric light purposes must take into careful consideration the merits and demerits of the governor user, as well as the economical generation of steam and the general design and workmanship in the engine.

The engineer could hardly be expected to produce a perfectly steady light even if he produced a perfect engine. The electrician knows this, and is constantly on the alert to introduce any modification in his design of dynamo machine or lamp that tends in this direction. One of the faults he had to contend against in olden days was the variableness of his magnetic field of force. He introduced a separate dynamo machine as an exciter to partially obviate the difficulty. Then certain lamps require continuous currents, and other lamps require alternate currents, but the designer was equal to the work, and both kinds of machine were forthcoming.

The Exhibition at Paris includes a large number of steam and gas engines, dynamo and magneto electric machines and lamps.



RANSOMES AND CO.'S SEMI-PORTABLE ENGINE.*

Messrs. Ransomes, Head, and Jefferies* exhibit a semi-portable and a small vertical engine, of which the former is employed to drive Messrs. Latimer, Clark, Muirhead and Co.'s exhibits, whilst the latter is shown at Messrs. Ransomes' own stand. The semi-portable engine is of 10 h.-p. nominal, and is a good specimen of the type of engine of which Messrs. Ransomes have supplied large numbers for driving dynamo-electric machines, and other similar apparatus. In order to secure the greatest possible regularity of speed, these engines are provided with Ransomes' patent automatic expansion governor gear, which is of extreme sensibility, and so contrived as to vary the admission of steam into the cylinder, and consequently the power developed by the engine in exact proportion to the work it has to perform, an arrangement which, of course, reduces the consumption of fuel to a minimum. One of Messrs. Ransomes' engines of this type, but of 20 h.-p. nominal, has been in use for the past two years for driving the electric light on the Thames Embankment. The exhaustive experiments which were carried out by order of the Metropolitan Board of Works showed that when this engine was developing 58 actual horse-power and driving sixty lights, the consumption of fuel did not exceed 3lb. per horse-power per hour. At the same time it was found that the action of the patent governor maintained such great regularity of speed that in an experiment extending over twelve nights the greatest variation in the mean number of revolutions each night was only 1·12 on an average of 142·36. These excellent results bear ample testimony to the care which Messrs. Ransomes have expended on adapting their engines for electric lighting purposes, and we are not surprised to learn that this comparatively new branch of the firm's business has very greatly developed itself of late. Amongst other advantages of semi-portable engines for electric purposes, we must not omit to draw attention to the fact that while the solid pedestals upon which they stand ensure perfect steadiness while they are at work, they can at any time and with but little trouble be mounted on iron road wheels, upon which they can be transported with the greatest facility, and be again dropped on to the pedestals upon arriving at their fresh destination. Messrs. Ransomes' *vertical* engine, 6 h.-p. nominal, is of a kind which has proved very handy for driving electric lighting machinery on steamboats, and in other situations where it was desired to limit as far as possible the space occupied by the engine. This engine is a very neat specimen of design and workmanship, and is, like the semi-portable, fitted with Ransomes' patent automatic governor expansion gear. The

* We are indebted to Messrs. Ransomes and Co. for the blocks to illustrate these engines.

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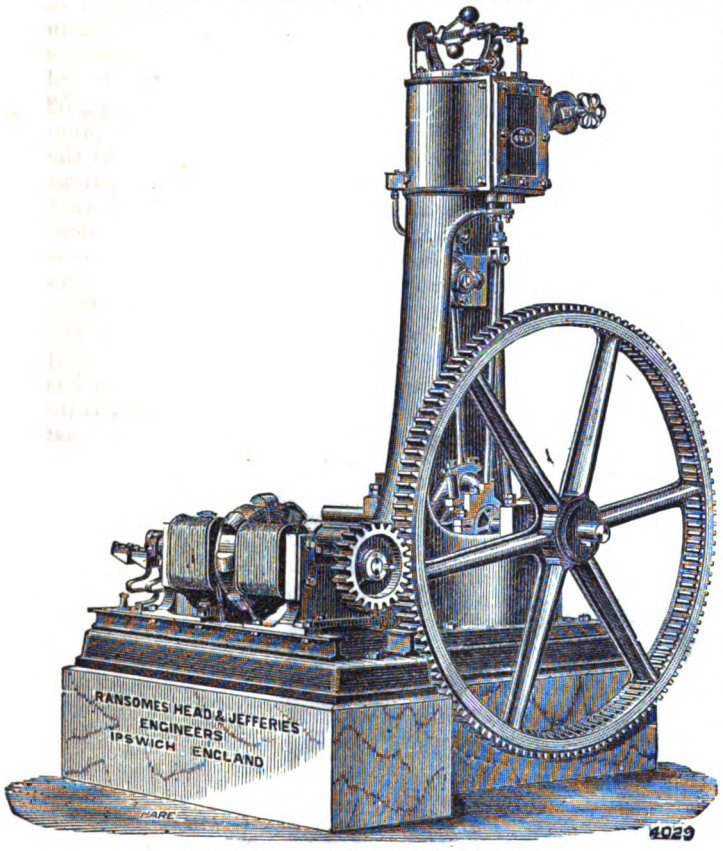
power can either be communicated from the fly-wheel by an ordinary driving strap, or else the fly-wheel itself is removed, and is replaced by a heavy spur wheel, which drives direct on to a pinion fixed on the shaft of the dynamo



RANSOME AND CO.'S VERTICAL ENGINE.

machines, which are in this arrangement placed upon the bed plate of the engine, which is specially elongated for the purpose.

We shall be able to extend our report next week when the exhibits are in a more forward condition.

CORRESPONDENCE.

"FISH BITES IN SUBMARINE CABLES."

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Under this heading I notice an article by Mr. J. Munro in your issue of August 6th. Will you allow me to contribute a little information on the same cause of damage to cables.

The cables owned by the International Ocean Telegraph Company between Florida and Cuba are divided into two sections by the Island of Cay West, and are known respectively as the North and South cables.

The cables in the north section are landed on Sanibel Island, which is separated from the mainland of Florida by the mouth of the Caloosa-Hatchee River, forming a small bay across which short cables are laid, connecting the cable ends on Sanibel with the land lines from Lake City, and which terminate here at a station built at the entrance to the river. The bottom on the Florida side of the north section, and throughout nearly the whole course of cable, is mud and sand, with an extreme depth of 13 fathoms; but for four or five miles on the Cay West side of this section the cable lies on reefs in a depth of about three feet.

The cables in the south section from Cay West to Habana lie on reefs to about 30 miles from Cay West, at which distance 300 fathoms are found. The bottom then changes to mud and fine sand with patches of stiff clay and gradually deepens.

I may premise that the damages I shall refer to have been found only in the north section, and in depths of under 10 fathoms.

The sheathing of the cables in this section (the north) has frequently been found crushed, and at these damaged places the sheathing wires are indented on two opposite surfaces, showing on each surface two lines of indentation, as if by the blunt jaws of some submarine monster. These indentations correspond exactly in size and appearance with such as would be caused by the jaws of the logger-head turtle, and to it this kind of damage is generally attributed. The crushing powers of the logger-head's bill are immense, and the local fishermen know of no other fish which could occasion such damage.

The only other large species of fish (putting aside sharks) on this part of the coast is a monster ray called the "Devil-fish." I have seen on the Florida coast a specimen of this fish 12ft. 3in. long, with pectoral fins 5ft. 8in. long and 2ft. 10in. wide at the base, but I do not think its jaws capable of the damage alluded to.

I do not agree with the author of the article on "Fish Bites in Submarine Cables" in supposing that a cable would offer to any fish "a tempting bait;" but it is probable that the damage may be caused by the fish seeking its food, such as shell fish, small crabs, and weed, on the surface of the sheathing wires. We all know that in tropical waters, teeming as they do with life, the sheathing wires offer an excellent bed for many varieties of animal and vegetable growth.

There is any but satisfactory proof, I think, that the saw fish is the culprit, for to me it is utterly incomprehensible why it should "attack" a cable, and, though not a naturalist, I have had some experience with fish in tropical waters.

It is to be hoped that Mr. Munro's article may be the means of our acquiring some information as to this curious and certainly inconvenient taste on the part of some fish for iron wire. I am afraid the only means of avoiding such damage would be to lay a heavier type of cable; for, as these attacks are heard of from many quarters, and as the fish supposed to be guilty of the damage are widely distributed, and are found over large areas, I do not well see how we can avoid them, since they have no particular haunt.

Unfortunately the "logger-head" if, indeed, this be the aggressor, is not the only enemy to cables in these waters. In the northern section the teredo, which here attains enormous size, is constantly at work, and wherever the sheathing wires admit of their entrance small crabs attack the percha. A curious fault was discovered in one of the cables between Sanibel Island and the mainland. The sheathing wires had opened, slightly exposing the core, and firmly adhering to the percha was a shell about half an inch in diameter. Everywhere outside the part covered by the shell the percha was in perfectly good condition, but directly under the shell the percha was quite hard and brittle, and showed two small transverse cracks.

I am afraid that I am rambling beyond the subject of Mr. Munro's article, but the matter is so interesting, and withal so important, that, once started on the subject of faults caused by external agency, it is difficulty to pull up.

E. MARCH WEBB.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I have been much interested in Mr. Munro's paper. My opinion on the fish bites, so called, being caused by the saw fish has been confirmed by the late Professor Buckland, to whom a complete serrature from the saw was submitted.

The seas around Madeira, Tasmania, and Cuba may be suitable for a fish found at 300 fathoms. The faults in question were picked up in depths not exceeding 50 fathoms. Again, the faults, generally, on both sides of Cayenne came up from a stiffish mud bottom, which fact makes it the more difficult to reconcile oneself to the probability of the cable being caught between the jaws of a fish.—Yours, &c.,

August 8, 1881. THOS. T. P. BRUCE WARREN.

P.S.—There are many other points in Mr. Munro's paper which require to be dealt with, and I hope at a future time to supplement this information.

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LIGHTNING AND TELEPHONE WIRES.

Herr Kirchoff writes, in a recent number of the *Deutsche Bauzeitung*, that telephone wires are more dangerous in cases of thunderstorms than telegraph wires. The reason, he says, is that "telephone wires are placed above the houses, and are nearer to the thunderclouds than the electric conductors. The influence of the clouds is therefore stronger and more quickly exercised on telephone conductors, which are more frequently struck by the lightning. When a telephone wire is struck there is every likelihood that the flash will pass along the conductor, down the supporting post, and thence to the house on which the post is erected. It will thus evidently effect great damage." In thus drawing attention to the serious dangers which may occur to both houses and their inhabitants, Herr Kirchoff points out the necessity of having the iron telephone posts connected with a good earth. On the other hand, M. Bede, of Brussels, has an article in *L'Ingénieur-Conseil* on the above subject. He considers that a system of such wires forms the best and most complete security against lightning with which a town can be provided, because they protect, not only the buildings in which they terminate, but also those over which they pass. At each end they communicate with the earth, and thus carry off safely any surplus of electricity with which they may become charged. It is, however, important that they should be provided with lightning conductors of their own, to carry off such surplus directly from the transmission wire to the earth wire, without allowing it to pass through the fine wires of the induction coils, which it might fuse. Such lightning conductors usually consist of a toothed plate attached to one wire, close to another plate not toothed attached to the other wire. The copper even of such a conductor has been melted by the powerful current which it has carried away. In telephonic central offices, M. Bede has seen all the signals of one row of telephone wires fall at the same moment, proving that an electric discharge had fallen upon the wires, and been by them conveyed to earth. This fact shows that wires, even without points, are capable of attracting the atmospheric electricity; but it must be remembered that there are two points at every join in the wire. M. Bede insists strongly upon the uselessness of terminating lightning conductors in wells, or even larger pieces of water. The experiments of MM. Becquerel and Pouillet proved that the resistance of water to the passage of electricity is 1,000 million times greater than that of iron; consequently, if the current conveyed by a wire one square mm. thick were to be carried off by water without increased resistance, a surface of contact between the wire and the water of not less than 1,000 square metres must be established. It is obvious that a wire let down into a well is simply useless. On the two-fluid theory, it offers no effectual way of escape to the terrestrial electricity; according to the older views, it would be absolutely dangerous, by attracting more electricity from the clouds than it could dispose of. The author advocates connecting lightning conductors with water or gas pipes, which have an immense surface of contact with the earth.

ELECTRIC LIGHTS FOR THE SS. "ROME."—This vessel, which was recently launched at Barrow, is to be fitted up with both arc and incandescent lamps. Messrs. Siemens Brothers have contracted with the Inman Company to fit her with sixteen of their 300 candle-power alternate current arc lamps, and 260 Swan incandescent lamps, which latter will be distributed throughout the saloon, drawing, and smoking rooms, cabins, &c. The whole of these lights will be driven by two of Messrs. Siemens's large size (W.1) dynamo machines.

THE FAURE SECONDARY BATTERY.—We understand that arrangements are being made with a view of experimenting on the utility of this battery for use on the Metropolitan Railway. The necessary apparatus is being constructed, and in a short time a public trial will be made, when one or two carriages will be driven by means of this battery. The company invites inspection of the battery at their offices in the Strand.

CONDITION OF FLAMES UNDER THE INFLUENCE OF ELECTRICITY.*

The experiments of the author have been principally directed to the alterations in shape and colour produced in a flame when under the influence of positive or negative electricity. The flames were arranged so as to form one electrode of a frictional machine. When charged with positive electricity the flame became more blue, narrower, and pointed at the top, while little or nothing of the result was observed in negative flames. A peculiar result is that the end of a negative flame returns to its own conductor, and that, according to the intensity of the electricity, and also depending on the width of the burner, this turning back of the flame is either intermittent or constant. Most noticeable are these results:—When the flame rises from a circular burner, or when burning round a metallic cylinder, in the latter case it returns to the metallic surface according to the intensity of electricity in an arc or angle, while the point of the flame divides into two branches, which separately perform more or less equal movements. If a body connected to the earth by a conducting wire is held opposite the flame at some distance, the flame will in all cases bend towards it; as the body is brought closer, the flame, if negative, will be repulsed, and, if positive, will be attracted, at least the upper luminous part of the flame, while the lower dark body of flame is also repulsed. This phenomena explains why a positive flame will burn through wire gauze, while a negative flame remains below the gauze. The positive flame becoming pointed explains the fact that this will drive a small fan wheel, while a negative flame will only just move it.

All these results are most prominently obtained with a pure gas flame, a stearine, wax, or tallow candle, very indifferently with a spirit flame, and least from a Bunsen flame, rich in oxygen. They may not only be obtained with flames electrified direct, but also when placed under the influence of a long "Holtz" machine.

A flame placed between two small discs on the machine bends towards the negative pole, becomes widened, and, at a certain point of electric intensity, commences to vibrate and oscillate, exhibiting a peculiar stratification. Since these phenomena are also least observed in flames rich in oxygen, it appears to be a general law that carbon and hydrogen are more strongly attracted by the negative pole, while oxygen is more attracted by the positive pole, probably like in all polar differentially attractions, in consequence of a peculiar unipolor conductivity of the substances.

The return motion of the flame the author explains thus: The point of the flame loses more electricity by influence than it receives by conductivity. A paper strip fixed at one end to a large ball shows similar movements when its free end is pointed and made conductive. Why principally the negative flame returns may be explained in two ways—either the point of the flame loses much by radiation, or the base of the flame is a bad conductor. The former explanation would agree with the experiments made by Wiedemann and Ruhlmann, the latter with Erdman's theory of unipolar conductivity of flames. This theory is still further supported by the resistance on the negative electrodes noticed by Hittorf, which almost explains Erdman's experiments, because if negative electricity enters a flame with greater difficulty, then positive electricity must leave a flame with difficulty.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES AUGUST 10.		BUSINESS DONE WEEK ENDING AUGUST 10. Highest.	Lowest.
Anglo-American	51¼,	52	52¼	51¼
Do. Preferred	82½,	83½	84	83
Do. Deferred	25,	¼	25½	25
Brazil Submarine	10½,	¾	10¾	10⅛
Cuba	9⅛,	10	9¼	9⅛
Do. Preference	16½,	17	—	—
Direct Spanish	4¾,	5¼	5¼	5¼
Do. Preference	13½,	14½	—	—
Direct United States Cable	10⅛,	11½	11½	10⅜
Eastern Telegraph	10¼,	⅜	10⅛	10¼
Do. 6 per Cent. Preference	12½,	13½	—	—
Do. 5 per Cent. Debentures, 1899	105,	108	—	—
Eastern Extension	11,	¼	11¼	11
German Union	10¾,	¼	10¾	10
Globe Telegraph and Trust Company	6⅛,	¼	6¼	6 9-16
Do. Preference	12¾,	13	13	12¾
Great Northern	13,	¼	13¼	13¼
Indo-European	28,	29	—	—
Mediterranean Extension	2¾,	3¼	3	2¾
Do. Preference	9½,	¾	—	—
Reuter's	12,	13	12¼	12¼
Submarine	290,	300	294	294
West India and Panama	1¾,	2	—	—
Do. 1st Preference	7,	¼	7 7-16	7 5-16
Western Brazilian	8,	¼	8¼	8¼
West. Union 7 per Cent. 1st Mortgage	125,	130	—	—
Do. 6 per Cent. Sterling Bonds	106,	110	—	—

* Translated from an abstract by W. Holtz in "Wiedemann's Beiblätter to Poggendorf's Annalen," 1881, Vol. V., No. 5.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

All communications to be addressed to 396, *Strand, London, W.C.*

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THE TELEPHONE.

The annual meetings of the telephone companies and of the undertakings connected with telephonic enterprise remind us that a new service has arisen and a new industry been created within the last year or two whose dimensions are altogether without precedent in the annals of commercial life. The rapidity with which the telephone has won its way into favour as a public convenience is as remarkable, if not so startling, as was the invention itself. Gas, and water, and railways, and even telegraphs, have all had to slowly make their way either against prejudices or against rivals of long standing. Not so the telephone ; it menaces no property, and provokes no ill-will. On the contrary, it has been welcomed in every quarter as a boon, and the only interests it has alarmed are those of the national revenue. Happily, those interests and the proprietory rights of the inventors have been completely reconciled, and there is now no bar to the universal application of perhaps the most unique and useful discovery of modern times. Telephone companies have a future before them which, if their affairs are managed with ordinary prudence, cannot fail to be highly remunerative. While the electric light is courting favour the telephone is being courted, and the obstacles which beset the progress of the one have absolutely never existed in the way of the other. Neither of these discoveries can be strictly described as supplying a "felt want;" but their merits as highly convenient luxuries are indisputable. But whilst in the one case the public has not quite made up its mind, in the other there never was a moment's hesitation—the telephone was no sooner invented than people wanted to use it, and at this moment the demands far exceed the possibilities of supply.

One main cause—perhaps the chief and only cause—of this unprecedented success is to be found in the instrument itself. It is hardly an exaggeration to say that the telephone was perfect as a speaking instrument from the moment of its conception. Combined with a microphonic transmitter, the apparatus satisfies everybody. Difficulties have arisen in the details of its application to public purposes; but they were no more due to any fault or defect in the telephone than leaky gas pipes are due to the gas; and the worst that can be charged against the telephone on the score of its susceptibility to induction is that an instrument so delicate is not fit company for rough neighbours. With fair play, and left to itself, the telephonic circuit is faultless, and it was so from the very first. Of no invention that we can call to mind could this have been said with so little qualification. Usually the first crude notion is not much inferior to the first attempt at realisation. Improvements follow one after another, and if the idea is good, and fortune favour it, some day it will be generally adopted. But the development has been slow, and public favour, discouraged by partial failure, has to be laboriously won. The telephone came to us with no such drawbacks. It did, not only all that it professed to do, but all that it was possible to do, once and for all. The reproduction of articulate speech at a distance was an achievement once accomplished could not be bettered. The sounds might be made louder, their reproduction more easy, but they did not need to be made plainer. This was the fact which the public realised at once, and while experts were discoursing on the scientific aspects of a very pregnant electrical revelation the world were demanding to have it for common use. It is possible that Mr. Graham Bell never dreamed of the application of his discovery to purposes so universal and popular, but if he did, it is certain he has no cause to complain that his hopes have not been realised.

We have said that the telephone has no rival. The telegraph has altogether different functions—functions which the telephone may usefully supplement but cannot supplant. In this relation the telephone is to the telegraph what the cab or omnibus is to the railway. There is a limit beyond which these local vehicles cannot be advantageously employed, and there is a limit also to the extension and multiplication of telephones. But locally and within quite intelligible areas the telephone is as serviceable for communication as a private brougham is for locomotion. For private use between office and warehouse, dealer and customer, workshop and master, and between home and business, the speaking magnet has found plenty of customers; but it will also help to swell the traffic on the trunk lines of the telegraph. This fact is already becoming apparent; and in our colonial and imperial possessions the value of telephonic facilities as feeders of the telegraph systems is beginning to be appreciated.

The one solitary institution which by any stretch of language could be called a rival to the telephone is the speaking tube. Its functions, however, are so very restricted and humble that we should not have referred to it but for a moral which may be usefully drawn from it just now. If the manufacturers of that useful device had taken to carrying their tubes across the streets, say from one first or second floor to another first or second floor opposite, what, we hardly need ask, would the general public, and the local boards have said? Yet the telephone companies are committing by degrees the very indiscretion which the proprietors of gas mains, water pipes, and speaking tubes have wisely avoided doing in the lump. There is nothing to choose between a gas pipe and a telegraph cable as far as appearance goes, and in point of safety some people would prefer the pipe. Yet if those old established servants of civilisation had behaved with as much short-sighted indifference to public opinion and public safety as is shown by the telephone extensions, instead of being looked upon as public benefactors they would have been voted a nuisance long ago. A career of unexampled prosperity is open to this latest beneficent gift of science. We hope it will not be marred by a conflict with public opinion, which, the longer it is provoked, the more costly will be the process of reconciliation.

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ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).

The ordinary general half-yearly meeting of the proprietors in this Company was held on the 5th inst. at the City Terminus Hotel, under the presidency of the Right Hon. Viscount Monck.

The SECRETARY (Mr. T. H. Wells) read the notice convening the meeting and the minutes of the last meeting, held on the 4th February, which were confirmed by the present meeting and signed by the chairman as correct. The report, which has been published in *The Electrician*, was taken as read.

The CHAIRMAN then said: It is now my duty to move "That the report and accompanying statement of accounts submitted to this meeting be and the same are hereby received and adopted." Gentlemen, in moving that resolution I have to bring before you a state of things which, though not particularly exhilarating, does not in my opinion afford any reason for despondency. You are all aware that the commercial depression of which we have heard so much for several years past, though considerably relieved, has not entirely passed away; but, notwithstanding the continuance to some extent of the depression, your receipts have shown a very healthy and continuous growth. Before proceeding to make some general observations on the present aspect of affairs I would just say a few words to you with regard to the report and accounts. Gentlemen, in reading the minutes of the last meeting you will have observed, as you will also probably remember and have felt experimentally, that the payment of a dividend under the peculiar cirumstances was postponed. That postponement on the part of the directors caused a little impatience—not very extensively shared by the shareholders—at the last general meeting, and, as you saw, a resolution was proposed (which was negatived) that we should pay it under an indemnity from the shareholders. The resolution, however, was not passed, and it is therefore not necessary to refer to it. The state of things which, in the opinion of the directors, rendered necessary the course referred to very shortly afterwards ceased, and the dividend was shortly afterwards paid, so that that transaction is closed for ever. Well, gentlemen, you are also aware that at the time of our last half-yearly meeting the French cable was out of working order. A fault had developed itself to such an extent that it was not capable of carrying the messages across the Atlantic. At that period of the year it was impossible to repair it, from the state of the weather. However, immediately the spring weather arrived, when we could send out an expedition with effect and advantage, we sent out and had the cable repaired, and I think that that repair is a remarkable fact in telegraphic history, and one that ought to give you considerable encouragement as to the permanency of your property. You are all aware that that French cable has been in the sea now for exactly 12 years. Well, it was taken up the other day in 1,700 fathoms of water and repaired, and is now, as our managing director tells me in good working order and doing its business well. Now, gentlemen, considering that two of our cables failed at the end of ten years' working, the fact that we are enabled to take up this cable and repair it at such a depth in the sea after twelve years' existence as a working cable is, I think, a matter of congratulation and encouragement. I have told you more than once in this room that, as to all the recent cables, before we proceeded to lay them, we tried to obtain, by every experiment open to us, all the newest inventions in cable laying and electricity; and the 1869 cable, which was laid some years after the two already taken out, has given evidence of the effect of our exertions in that direction, and shown that it possesses more vitality than the cables previously laid down. Well, we have been carrying on the same system with the cables laid down since 1869—those of 1873, 1874, and 1880. We laid three cables in those years, and I think the effects which have been apparent in the additional vitality which has been shown in the 1869 cable may be expected in an enhanced and greater degree in reference to our cables more recently laid down. Gentlemen, in connection with that I will only say that the remainder of your cables, including the Brest cable, are now in good working order, and carrying the traffic as well as could be expected from them. Well, gentlemen, having said so much about the report, I wish to say a few words about the accounts. The gross total of the expenses in the half year ending June, 1881, has been £61,885 19s. 6d. Now, those are the gross expenses, including the payment of the income-tax on your dividends and the repairs of cables—in fact, every expenditure that has been made by the directors during the half year. I have often said to you that it is rather fallacious to compare the half year we are now considering with the half year immediately preceding, because there are certain expenses which occur at particular times of the year; and therefore the fairest comparison is to compare each half year with the corresponding half of the previous year. Now, the gross expenses in June, 1880, were £56,044 9s. 9d., showing an apparent increase in the expenses of the past half year of £5,841 9s. 9d. Well, gentlemen, in round figures —I don't want to trouble you with minute details on a hot day like this—I can account for the whole of that sum under three items. In the first instance the cost of the repairs this half year was £1,977 13s. 2d. greater than in the corresponding half of last year. You are aware that we laid down an additional cable last year, and, of course, if you have to work an additional engine, you must have additional hands to work it. The working expenses, as you will see by looking at the account, in London and at the stations are £1,907 14s. 5d. this half year in excess of the half year ending June, 1880. Well, gentlemen, I shall have a word or two to say presently about the aspect of affairs as regards our interests on the other side of the Atlantic; and I may incidentally here say that immediately after the last half yearly general meeting the aspect assumed in our opinion such a form that we thought it necessary that you should have an accredited and confidential agent in New York to ascertain thoroughly the state of affairs, and to take such steps as might be necessary to further your interests. The board, therefore, unnanimously agreed to send our friend, Mr. Birt, our excellent legal adviser, to New York. He was there for three months, and the balance of the difference between the two half years, in addition to the sums I have already referred to, is accounted for by that fact. Now, gentlemen, I give you these as round sums, I don't go into minute details. I daresay if you scanned the account with a microscopic eye you might discover items less one half year than another; but in the main the additional expenses are accounted for in this way. Well, gentlemen, that being the case, I want to point out to you as to the increase which has taken place in your business, to which I shall have presently to advert, that it necessitates an increase in the expenses of carrying it on. Every business man knows that he cannot conduct a business of £1,000,000 a year at the same cost as he can conduct a business of £100,000 a year; and that is one of the reasons why there is a slight apparent growth in the expenditure of your Company. Well, I have alluded before now in addressing you to the fact that as the officers of the Company grow older in your establishment you cannot avoid every now and then giving them a slight increase of salary. But there is another consideration which you will have to take into account in connection with these expenses, and that is the increase of telegraphy all over the world That increase of telegraphy, and especially what I shall have to notice presently—the new cables that are being laid down to America —of course create a great demand for skilled telegraphic operators; and if you wish to retain in your service men of experience and skill you cannot allow them to be tempted away from you by higher salaries offered by other companies. That is an ordinary business principle which I am sure you will all appreciate. Well, having said so much about the accounts and report, I now come to a subject very largely dealt with in the report, and to which I have already incidentally alluded—the state of affairs on the other side of the Atlantic. Now, gentlemen, this company has been often held up as a great monopoly. We have been told that we want to appropriate to ourselves the whole trade across the Atlantic; and, as far as the accusation implies any blame for the intention, I am quite willing to submit to it. If I could I would keep the whole traffic across the Atlantic in the hands of the Company, and pay my shareholders 12 and 15 per cent. on their capital, but unfortunately we cannot do that. We have been, as I have said, accused of being a great monopoly. Now, gentlemen, what does that accusation imply? I take it that the only objection to a monopoly is that you get your business badly done by it, and have to pay dearly. Now, with regard to the mode in which we transact our business, I don't think that that has ever been found fault with. For the last month the average delay of messages between London and New York, over all the cables we possess, has been something like eighteen minutes, and I don't think that that is a delay which can be much complained of by the public. With regard to the cost at which we do our work, we have been for the last year, ever since our arrangement with the new French Company, doing our work at 2s. a word. Now, gentlemen, I just ask you to consider for a moment what relation that price bears to the price which was paid for telegraphy when the cables were first laid across the Atlantic. In 1866, when the first cable was laid down, the price charged for any message, no matter of what length, under twenty words, was £20. Well, gentlemen, you can send a message of twenty words now for 40s.—or you could do so up to the 1st of August, for you can do it for less now. That is a reduction from £20 to £2, and I don't know what people expect from competition. That is a very large reduction, and quite as much, I should think, as you are likely to get by any competition that might be brought to bear on it. Now, gentlemen, when we talk in this way, I would remind you that it is not at all the business of your directors or of this Company to work for the public at an unremunerative rate. I think that we are entitled to get any rate we can for the transaction of your business, and to put it into your pockets; and when I talk of this great reduction in the price at which we have been doing business across the Atlantic, I don't mean a bit to attribute any of it to philanthropy. We thought it would bring in more money to your pockets, and it has done so. Well, gentlemen, I had a conversation this morning with my excellent friend beside me—our managing director—and we were going back on our reminiscences as to the past working of the Company, and he said to me, "We have never been out of trouble." Well, I am afraid, constituted as human nature is, that when you get hold of a good thing there are many who want to get a share of it; and I believe the fact that we have never been out of trouble in regard to competition is the very best proof of what a good thing we have in Atlantic telegraphy. [A voice: Four per cent. Laughter.] The first trouble this Company had, as you are aware, was with a company of which I was chairman—the French Company. Well, after a very short time we came to an arrangement as to a joint purse, and very shortly afterwards the two companies were completely amalgamated, which resulted in my having the honour of becoming your chairman. Gentlemen, that proceeding was attended with very considerable advantage to both companies, but it had some corresponding disadvantages, which induced your directors to come to an arrangement that in future they would not agree to amalgamation. Next came the Direct Cable Company, and, after a long contest and competition, we came to a joint purse arrangement with that company. Now, gentlemen, at first sight it would seem as if we should lose everything we possess by gradually giving away, in this manner, certain proportions of our traffic, but the fact is that there is a fallacy at the bottom of that, because the increase of traffic was so enormous that, to use an apparent paradox, the half was greater than the whole. The half of the traffic as it grew—and our share of the traffic is more than half—became much larger than the whole of it, when it came into our own pockets before this growth. Well, we next performed the same operation with the French Company. We made an arrangement for a joint purse with them, and we have had, under the working of the company for the last six months—the half year which we are now dealing with—the experience of what the effect of that arrangement was. Gentlemen, you will see by looking at your report that our distinct receipts during last half year, apart from those taken by the Direct and the French Companies, were as nearly as possible £300,000. I need not tell you that if we could secure an income of £600,000 a year, the shareholders of this Company would have no reason to complain. Therefore, I say that, though it seems an improvident arrangement on the face of it to give away gradually proportions of our receipts in order to arrange with these companies, the growth of the traffic was so large that the proceeding was a profitable one for us, and it afforded an opportunity for great economies in the management of the different companies, which would not otherwise have been attained. Well, gentlemen, last spring we received intelligence of the creation of what is supposed to be, or is assumed will be, this leviathan company at New York. As I told you already, we delegated Mr. Birt to go out to New York, and to take such steps in communication with the board at home as he might find necessary for the protection of the Company's interests. We found that this new company beyond all doubt was formed, and was about to lay two cables. Well, we were willing on certain terms to come to an arrangement with that com-

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pany; but of course the propriety of these arrangements all depends on the terms which you can obtain, and Mr. Birt was not able to obtain such terms at New York as we considered would warrant us in assenting to them, or recommend you to assent to them. Well, that being the case, your directors had to consider what policy they would adopt. Now, if we had come to an arrangement for a joint purse with the New United States Company, of course it must have been on the supposition, the speculation, that the traffic would so increase as to give us sufficient income, as one of four participators instead of three. Well, being unable to arrange the matter on the basis of a joint purse arrangement, we had to cast about for a policy which would produce the same effect. We have adopted the resolution of going to 1s. a word in the tariff. Our expectation and hope is that after we shall have given that expedient a sufficient trial it will so stimulate the growth of cable traffic that there will, to use a homely phrase, be room for us all. I ventured to predict two or three years ago, when the French Company was formed, that the traffic was growing so large that there would be room for us all, and though I don't set up for a prophet, I hope and expect that the same result will accrue from the adoption of the 1s. tariff. At the same time, the reduction by one-half of the charge made for the messages is a considerable drop; and the directors trust that they may still reckon on the forbearance of the shareholders if for a few months the receipts may not show such an increase as will produce at the end of the half year so large a sum of money as we have now to lay before you for the produce of the last half year. We believe most strongly that that effect will ultimately be produced, but that there may be a time during which you may be obliged to submit to lower dividends. Well, gentlemen, we mean, as at present advised, to give the principle a fair trial. You are all aware (I have already alluded to it) of the great growth that has taken place in the traffic across the Atlantic. We have found from time to time, as we adopted a lower tariff for the purposes of competition and conflict, that when we returned to a higher tariff there has been a great increase of business, and I think it is not very difficult to explain why that is so. When a commercial man once begins conducting his business by telegraph he cannot stop; he must strike a whole fortnight out of his life if he stops there, because he if telegraphs to-day and writes to-morrow, his letter will not get to New York till at least ten or twelve days after the telegram. I believe that that is the reason why we have always found a large increase of business succeed a low tariff. Men are induced to go in at a low tariff, and then they cannot stop. However, be that as it may, we believe that this was the only possible way of meeting the state of things that has sprung up in America. Let me say, in speaking of that, that I entertain no feeling of hostility or animus to the Americans wishing to have cables of their own. My only astonishment is that, with such an energetic and enterprising people they have not had them before. For the last fourteen or fifteen years they have been exceedingly good friends to us, and brought a great deal of grist to our mill, and if they are going to try their hands on their own account I see no reason why we should entertain any ill feeling towards them. I believe there is room for us all, and that, at all events, it will be shown that there is room for us all; and we must only trust that by performing our work in the excellent manner in which it has always been performed hitherto, by economising to the utmost degree consistent with efficiency in our management, and by drawing towards us every influence which we can command in order to increase the traffic, we may still hold our own against this gigantic confederacy in North America. With these observations I beg leave to move the resolution.

Sir JAMES ANDERSON having seconded the motion,

Mr. SEELEY stated that at the last meeting he rather criticised the lowering of the tariff, but, to his very great pleasure, he found that the reduction of the tariff had not reduced their interest, as he feared it would do. He was very pleased that the lowering of the tariff to 2s. a word (about 33 per cent.) had really called forth an increase in their traffic of about 40 per cent. If it turned out for them that the lowering of the tariff by a further 50 per cent. should produce a like result—although it was hardly credible to his mind that it could do so—it would be a good thing. He looked to it with some anxiety, but not with the same anxiety as he did the former reduction. The directors must know more about the matter than the shareholders. The amount put down to sundry debtors had grown. In England they went to the telegraph office and paid their money, and why this money was put down as owing he could not understand. Although, too, the item of sundry debtors was down for a large sum, £83,000, there was still another large item, bills receivable, and the two together amounted to something like £150,000. That was rather a large sum. Supposing these gentlemen who owed this sum to the company were not to pay, it would very seriously affect some of their future dividends. It was nearly 2 per cent. on their entire capital. Of course, as to their working expenses, they must increase.

Mr. W. ROE thought that the chairman had made a very agreeable discovery. They were told by the chairman that they were in a good thing. He really did not know it. He considered that the reports were very meagre. There might be something in the Company that was really good, but he should like to know it. At the same time he confessed that he was in a fog. He did not think it a very good thing to get rather an uncertain 4 per cent. for one's money. He should like to have had some little more definite information as to what the position of this Company was with the companies on the other side of the Atlantic. He should have thought it would have been the duty of the directors to give them some explicit information as to what their arrangements were with them. At the last meeting he asked for the publication of the receipts weekly.

A SHAREHOLDER: We have them monthly.

Mr. ROE was not aware of it. They used, however, to have the receipts published weekly. They had spent about £2,000 in sending a representative to New York, and he thought they should have seen something good arise out of it.

Mr. NEWTON stated that reference was made in the report to the action Thorne *v.* the Company. That was, he said, a direct attack on the Preference shareholders of the Company and their right to their 6 per cent., and it was an attack on no one else. He would like to know who were the parties behind the man Thorne, as, in his opinion, it was incumbent on the directors not to allow such an attack without making the fullest investigation into the matter. He should also like to know whether, before making any arrangement with Mr. Jay Gould, they would call the shareholders together and let them know the terms and conditions.

Mr. GRIFFITH regretted that the directors had only hope to lay before them. They did not, he said, seem to have confidence in themselves or hope in the future of the Company. It was, however, fortunate that they were able to say that the business had so largely increased that it was sufficient not only for the Company but also three other companies. He thought that more energy might have been shown in meeting Mr. Thorne. He also asked what had been done to protect the rights of the Company in America. He was sorry that more energy had not been shown in that matter also. They had a contract which bound a company to carry this Company's business, and this Company's business exclusively, and what was done? They were told that because they were so sure of their rights that they could wait till they were attacked; but with all respect to the solicitor of the Company, he would say that the principles of contract were more sacred than that, and that they were not obliged to wait till there was a breach of the contract. They had the situation in their power, and they were told that as their position was unassailable, they could wait; but he contended that their position being unassailable, they ought to have prevented the amalgamations from taking place. They had their concessions with the American and the French Governments—

The CHAIRMAN: Not with the American Government.

Mr. SMITH observed that the Company had now four cables and a reserve fund of £300,000, and he considered, therefore, that while the battle was being fought no further addition should be made to the reserve fund than what accrued from the interest which it produced.

The CHAIRMAN, in the course of his reply, said: With regard to Mr. Seeley's remarks as to sundry debtors and bills receivable, I may mention that if he looks to the opposite side of the account he will find sundry creditors just in the same category. The fact is that we have relations with very distant parts of the world, and though we can obtain immediate telegraphic advices from them, these sundry debtors and creditors are settlement of accounts between ourselves and our agents in different parts of the world. Probably a great deal of them have been settled by this time. It is simply a question of account, and has nothing to do with trusting people as creditors or debtors. It is simply a question of account. The money had not come here, and we could not deal with it as if it had been received. On the 30th of June we had in reference to the past half year £33,000 due to us, which was just as good as if the money had been in our pockets, but had not been transferred to our pockets. Mr. Roe commented on a phrase which dropped from me, and I think he rather misapprehended what I said. He said that I had expressed an opinion that the shareholders had a good thing, and he said, did you think that 4 per cent. was a good thing? That is not the sense in which I meant it. Before the competition began 4 per cent. was not what you were earning. When the French and the American Companies amalgamated the French Company was earning 12 per cent., and the American Company 8 per cent. That is what I call a good thing, and it was that which attracted to the subject of Atlantic telegraphy other speculators who were possessed of money, and who thought that they would make 12 and 8 per cent. You cannot expect when several people are sharing in the same thing, that each will have the same amount that fell to be shared when it belonged to only two people. I did not mean to say that 4 per cent. was a good thing. I wish I could give you 8 or 10 per cent.; but what I meant was, that when we started, we made such a good thing of it that it attracted others to it; and that was the natural course of events. Mr. Roe and Mr. Griffith also referred to the land companies in America. As to the Western Union Company we have a working agreement with them—an exclusive agreement.

A SHAREHOLDER: For how long?

The CHAIRMAN: Fifty years from the original date, but it is practically perpetual. We have that exclusive agreement. That agreement as far as we know up to this moment has not been in the slightest degree infringed. They carry our messages just as well as ever as far as we know, and they are fulfilling the terms of the agreement as rigidly as ever. Mr. Griffith is a lawyer, and I am not; but he tells us that it was the business of the board not to wait till the agreement was infringed, but to apply to a court of equity for an injunction to restrain them. I do not pretend to be as good a lawyer as Mr. Griffith, but I should not like to be a party that went for an injunction in a suit like that. The Chancellor would say, "How can I give an injunction when you say that they are performing all that they engaged to perform. You say that you require an injunction because they might not perform their engagements to you." That reminds me of the story of the schoolmaster who flogged one of his boys, not because he had done anything wrong then, but because he might in the future [laughter]. This company has performed its duty to us. We have no case against it on which we could go into court, and if we went into court in such a case as Mr. Griffith has illustrated, we should, I think, be laughed out of court. Mr. Newton put some questions to me as to the action of Thorne against the Company, and I wish with Mr. Newton that we could "spot" the people who initiated the proceeding, and if we could do anything to prevent them doing anything of the same sort in the future we should; but I don't think it is the business of the board to go about investigating such a question as this. Mr. Griffith also said that we were the oldest company, and asked in reference to the company now started in America, or any future company that may start, why should we not have the largest share of the traffic. Well, we have. The arrangements we have made with the other companies have always given us the largest share of the transaction; but if companies multiply to such an extent, over which multiplication we have no control whatever, I don't exactly see what agency Mr. Griffith would put in operation to get us a larger share than the natural course of events would give us. We do our best to get as much as we can, and if other people start companies, which cause the traffic to be divided among a larger number of competitors, I don't see how we can get more than an adequate portion of the traffic than nature would assign to us. Mr. Smith alluded to the reserve fund, which, I am afraid, is rather a delicate subject for me to touch on. I have had a large amount of pressure put on me in relation to that subject. My conviction remains what it has always been—that the first duty of directors managing a company of this kind is to secure a fund which will give permanency to the agency which earns money for you. That is my thorough conviction with which I started in conducting the business of telegraph companies, and I think that last year you had a pretty good proof of the wisdom of that course when you were able to lay down a telegraph the whole way across the Atlantic without drawing on the shareholders or the public for a single shilling, and when you have now at your bankers to your credit

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an amount which would very nearly enable you, if required, to lay down a new cable. If that state of things does not convince your minds of the wisdom of the course hitherto adopted by the board, I cannot say anything which will attempt to influence your intelligence. We have been accused of want of candour and reticence in giving information in a way that I confess I cannot understand. I don't know of anything that we could give you which we have withheld. If we don't know things ourselves we cannot tell them. We have done all that we could to obtain information, and have told you in this report every tittle of information that we possessed. I cannot manufacture information for the shareholders. I tell you what we know and believe to be true, and what we have discovered from the investigations we have set on foot.

Mr. BIRT wished to say a few words *apropos* of the remarks of Mr. Griffith. He would not care to do so, however, having been the solicitor of the Company for the last 17 years, but that what Mr. Griffith said seemed to reflect on the conduct and judgment of the board. He (Mr. Birt) had been for many years taught that the duty of a solicitor was, if possible, to keep his client out of litigation, and he confessed that that was the course which he had always adopted in dealing with this Company and its board; and he thought he might take credit for keeping them out of litigation with the Western Union Company of New York. He felt satisfied that had Mr. Griffith been by his side in New York, and knew what he (Mr. Birt) and others knew, that he would not have made the observations he had made on that occasion. There were four suits fought most vehemently in New York when he was there. The Direct and French Companies brought an action, and the Anglo Company was somewhat complained of for not joining in that litigation, but their position seemed to him to be unassailed. So long as the Western Union Company amalgamated other companies to it, it would bring so much traffic to the Western Union Company, and if the Western Union Company did not break their agreement (which they had not done) to hand the Anglo Company all the traffic they received, it was clearly to the interest of the Anglo Company that the Western Union Company should amalgamate with other companies. There was, as was said in the report, a very important agreement taken over by the Western Union Company which upset that calculation, and if it had been carried out it would have prejudiced the position of the Anglo Company; but he thought he saw in the course of the litigation that was going on that that agreement must be broken down or cancelled, and in consultation with, perhaps, the first lawyer in America they came to the conclusion that it was the business of the Anglo Company to wait till they were attacked, and that until the Western Union Company broke their agreement with the Anglo Company it was their policy not to embark in litigation. Remarks were made as to the expenses incurred, and he could only say that he wished that Mr. Roe had been in his (Mr. Birt's) place—twelve days crossing the Atlantic in February. He felt sure that the expenditure incurred in this direction had saved them six times as much, as but for his visit to America he felt sure that litigation would have commenced. Had they begun they would have had a most severe fight with their own agents—a company with whom they had been working in the most amicable way for fourteen years, and for forty years afterwards they would have been the deadly enemies of the Anglo Company. With what result, too, would the litigation have been attended? He believed that they would have shared the same fate as their allies, and that each and all would have been dismissed. Under those circumstances he thought that the meeting would not think him out of place in what he had said. He should also like to say a few words as to Thorne's action, concerning which Mr. Griffith, utterly ignorant of the circumstance of the case, thought fit to charge the board and through the board himself (Mr. Birt) with want of energy. He was confident that if Mr. Griffith had known the steps that were taken day by day, the anxiety, and the efforts put forth, to get rid of that action, he would not have said what he (Mr. Birt) thought was somewhat unkind. But for his going to Leeds and seeing people connected with the man Thorne, and getting hold of his trustees in bankruptcy, the Company would not have been able to compromise that action, and if it had continued their dividend would not have been paid.

Mr. GRIFFITH replied that if he had said anything to pain their worthy solicitor he regretted it. He regarded Mr. Birt as a man of great courage and prudence, but he merely argued on the facts stated in the report—that the Company had an exclusive agreement.

Mr. BIRT observed that it was in consequence of that that he thought it unnecessary for the Company to bring the action.

Mr. ROE thought it was the ambiguity of the report which caused these discussions.

The CHAIRMAN then put the motion to the meeting, and it was carried.

On the motion of Mr. SEELEY, a vote of thanks to the chairman and directors was passed unanimously.

The CHAIRMAN: I am very much obliged to you, and I hope that we shall continue as good friends as in the past.

The proceedings then terminated.

WEST COAST OF AMERICA TELEGRAPH COMPANY (LIMITED).

The fourth ordinary general meeting of this Company was held on the 5th inst. at the Cannon-street Hotel, under the presidency of Mr. Neil Bannatyne.

The SECRETARY (Mr. F. L. Robinson) read the notice convening the meeting, and the report of the directors was taken as read. It stated that the gross revenue for the year ending December 31, 1880, was £17,398, and the expenditure £31,815, leaving a balance of £14,416 to the debit of revenue account. At the time of issuing the last report, three sections of the Company's cables were cut and out of use, and it was only since the cessation of the war that all the sections had been repaired and the entire system put into complete and perfect working order. All the Company's cables were now in active operation, and ready to take advantage of any increase of business that might be brought about by the revival of trade, and the re-establishment of peace on the Coast. It would be satisfactory to the shareholders to learn that during the repairing operations their manager had many opportunities of inspecting the general condition of the cables, and that he reported they were in as good a condition as when they left the works of the manufacturers.

The CHAIRMAN, in moving the adoption of the report and accounts, said that they would see from the report that since their last meeting they had laboured under great disadvantages, and that the intervening period had been one of much suspense and anxiety to the directors. The war had been going on, and had put everything at sixes and sevens, and their traffic had been stopped. Their lines had been injured, and altogether they could not under such circumstances expect anything but very bare and inadequate results on their capital. The receipts for 1880 amounted in the gross to only £15,365, or £1,280 a month. During the last month and a half—that was, of course, since the cessation of the war—their receipts had amounted to £5,000, nearly three times more—£3,300 as against £1,280. Another unfavourable feature during the unfortunate time to which he referred had been that the working expenses, of course, had gone on all over the system. They could not be stopped. The working expenses on their repairing ship had gone on at a very high rate of increase in consequence of the war, and the earnings of that steamer had been comparatively very small indeed. As regarded the vessel, however, he was glad to be able to say that they had also entered on an improved state of things. She was now employed in remunerative work, and, of course, her expenses would be very much diminished in the future and they hoped hereafter would continue very much to decrease. He might mention, as it showed the capacity of their staff in reference to cable work and repairing cables, and also as it showed the adaptability of their steamer, that during the past year the Iquique-Arica and Valparaiso-Serena sections were repaired by their repairing steamer, the "Retriever," and since the beginning of the present year the Iquique-Mollendo and Mollendo-Chorrillos sections had been repaired, and the whole system of the Company was now in perfect working order. Any shareholder might judge for himself how important a matter it was that they should have a steamer there that was competent to repair any cable that was broken, and what a loss of time, what an expense, and probably what a consequent considerable loss of traffic might occur at any time if a cable were to give way, and they had no vessel that could be easily got at to effect the necessary repairs. It was also satisfactory, he thought, for the shareholders to know that they had more than one man on the coast among their *employés* who was perfectly competent to repair a cable. They could see how prejudicial it would be to the interests of the Company if, whenever a break occurred, they had to send out a man who was scientifically qualified to do the work.

A SHAREHOLDER asked if the breaks referred to were in deep water.

The CHAIRMAN: At various depths. Turning to the receipts, he stated that for the seven and a half months up to the 15th of July last they were estimated at £15,200. Of course that was including a period when the great improvement had not begun (the great improvement began about the 1st of May); but notwithstanding that the receipts for the period mentioned were as much as for the whole of the year 1880. As regarded their financial position—that was to say in reference to the unpaid interest—the debenture coupons due on the 31st of December last amounted to £5,920. Of that amount £2,560 had been paid, and they had advices of remittances which would enable them shortly to pay the balance due on those coupons; and the next payment would be on the coupons due on the 30th of June last. Reference was made in the report to Mr. Rose-Innes, who had been on the coast some time rendering valuable service to the Company; and he might say that they had a letter from him dated the 21st of June, in which he said, "The traffic here has been good. I hope by the next steamer, and that of the 20th July, we shall be able to send you good remittances." He did not remember anything else that occurred to him to tell them, but he should be happy to answer any question.

Mr. ROBINSON KENDAL (director) expressed his pleasure at seconding the motion. There was this element about the report—that it showed the worst of everything. The lines at that moment were in really excellent working operation, and he thought that with the re-establishment of peace and with the revival of business the Company would be in a position, with a long line of telegraphic communication in excellent working order—connecting, so to speak, a great Continent, to take advantage of any increase of trade and revival of business. The chairman had omitted to take cognisance for a moment of the claim of the Company on the Chilian Government, which the directors had pressed, and which they would continue to press with the utmost urgency consistent with prudence. If they had not made greater progress towards a settlement than they had done, it arose from the fact that in Chili they had had a general election for the last two months, and all the officials had been given up to a political warfare. There was nothing he thought that they could see which could militate against the progress of the Company. They knew the worst of everything, and everything in the future must tend to the good.

Dr. BEATTIE asked to whom the £2,500 interest on debentures had been paid?

The CHAIRMAN replied that, as he understood, all the unpaid debenture coupons due on the 31st December last were in the hands of one holder, and they had been paid that sum on account. No other person had any claim on the money for those coupons, and they thought it only right to them and to the character of the Company that they should pay them as soon as they could. The coupons were overdue, and if Dr. Beattie held any of them he had no doubt that if he went to the secretary he would be paid, as would any other shareholder in the same position.

Dr. BEATTIE said that he had tendered them at his bankers, and they called for the amount, but they were returned. He found no fault with that, because he did not see how they could have paid in full, only he had wished to know whether any preference had been given over others. He asked whether interest would be paid on overdue interest, observing that if it was not in accordance with law to do so it would be in accordance with justice. He referred to a notice which he gave at the last meeting that no gentleman should be eligible to seat at the board unless he had held his shares for three months. The usual—he might say universal—practice was to append such a notice as that to the directors' report. He asked why it had not been done in the present case, as its omission prevented him from moving a resolution on the subject.

Colonel TILNEY expressed his satisfaction at the remarks of the Chairman and of Mr. Kendal in reference to the working of the Company's system. They gave great confidence in the future. The fact that the receipts of the period mentioned of the present year had been as much as in the whole of the year 1880 gave very great promise to the shareholders, and augured a prosperous future for the Company. He noticed in some

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items that there had been a curtailment of expenses, but he would not go into figures.

The CHAIRMAN, in reply, stated that he was not aware that Dr. Beattie had given written notice of his resolution, but such an important step as altering the articles of association could only be carried out by calling a special meeting. They would do the best they could to get as early a settlement as possible from the Chilian Government. The motion was then put and carried unanimously.

Mr. A. R. JOHNSTON then moved the election as a director of Mr. W. E. MacAndrew and Mr. T. F. Campbell in the place of Mr. Bannatyne and himself, who retired. He stated that the gentlemen mentioned were friends of Colonel Tilney and Mr. Kendal, who now held the great proportion of the shares.

Colonel TILNEY having seconded the motion,

Mr. M. GRAY (director) expressed his great regret at the retirement of the chairman and Mr. Johnston, who had been connected with the Company from its inception. He went into a long history of the Company, explained the manufacture and the laying of the cable by the India Rubber, Gutta Percha, and Telegraph Works Company, alluded to the various difficulties which the directors had had to contend against, and complained of their being turned out of office now that the Company in all probability was entering on a career of prosperity.

After some further discussion the motion was carried *nem con.*

On the motion of Colonel TILNEY, Mr. Weise (of the firm of Messrs. Turquand, Youngs, and Co.) was elected auditor of the Company.

A vote of thanks to Mr. Johnston and to the chairman was afterwards passed, on the motion of Colonel Tilney, seconded by Mr. Kendal, and the meeting was then brought to a close.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY (LIMITED).

The ordinary general meeting of the above Company was held at the City Terminus Hotel on the 5th inst., under the presidency of Sir James Carmichael, Bart.

The SECRETARY (Mr. Edward Tombs) having read the notice convening the meeting, the report of the directors was taken as read. It stated, *inter alia*, that the last half year's balance-sheet to the 30th of June last showed an increase in the traffic over that of the previous six months of £631 19s. 6d., and the amount to be claimed under the guarantee of Her Majesty's Government would be proportionately diminished. The Company's cables are in good order, and the cost of maintenance had been trifling. The directors proposed payment of the usual dividend at the rate of 8 per cent. per annum, less income-tax, on the Preference Stock of the Company, and at the rate of 3 per cent. per annum on its Ordinary Stock, payable on and after the 12th inst., leaving £462 to be carried to the reserve fund. The revenue account showed that the receipts for messages during the half year ending the 30th of June had been £2,426; the net receipts were £773; and the amount due from the Government to make up a minimum surplus for appropriation of £3,600 was £2,826.

The CHAIRMAN expressed his pleasure at having to move the adoption of the report and accounts, and begged to call their attention, in the first place, to the satisfactory improvement which had taken place in their traffic. It was not very large, but, to a certain extent, was promising, because it showed that the effect of the word rate was now coming into play, and he thought that in all probability the increase would continue, and that the traffic would become more and more extended by and bye. There was a clause in the report which, no doubt, they would have noticed, respecting a communication which had been received from another telegraph company, for purchasing the undertaking of this Company. That question would require some little explanation, and he, therefore, thought it would be more convenient if they first disposed of the report. He should be happy to answer any question.

The Hon. A. PONSONBY seconded the motion, and it was carried unanimously.

The CHAIRMAN said he would now call upon their colleague, Mr. Robinson, who had been in communication with a director of the other telegraph company respecting the matter. At present it was quite in an informal shape, and they could do nothing that day. They wished, however, to gather the opinion of the shareholders, and if they found that they were desirous that the negotiations should be continued, they would be most happy to do their best to bring about a favourable result; but before anything was done they would have to call them together at a special meeting, and probably two special meetings would have to be called to carry out anything definite. At present he might say that the matter was in the nature of a private communication to the board.

Mr. CHARLES H. ROBINSON observed that the matter alluded to by the chairman was one of great importance. An arrangement with some other company was a subject which had been mooted by the board from time to time, to see if terms could not be arranged so that, when their subsidy was entirely exhausted, the Company should not be left without a dividend. When he approached this question first of all he was very much disheartened, because the company he alluded to did not seem to entertain the question with any apparent hopes of success. He was, in fact, "snubbed," but a better feeling was subsequently entertained. The company from whom he received this communication they had had several interviews with, and at last he got something like a definite suggestion—he would not say proposal, because before anything could be done in the matter they desired to have the opinion of the shareholders as a body, and the views of the preference shareholders also. They had been receiving fair dividends, and, of course, at the termination of their subsidy, in about a year and a half, they would see how they would stand as regarded their traffic. The board had meantime instructed him to continue the negotiations with the other company, and he had endeavoured as far as he could, in conjunction with themselves, to obtain a suggestion which they thought would be adopted by them and acceded to by the shareholders of this Company. The suggestion—which had not been officially before the directors of either company—was this, and they desired to ascertain how far it was a basis upon which to proceed:—It was suggested that this Company should be taken over, and that the ordinary shareholders should be paid £2 10s. for their shares. According to the market price, they were about £2 15s. or £3, but their opinion was as good as his as to whether the market would stand a number of shares being placed on it at that price. The suggestion as to the preference shareholders was a maximum dividend of 3 per cent. given to them by some preferential shares in that company, or some other telegraph company equally as eligible. It was for them to consider how far that suggestion was sufficient to induce them to sell their undertaking or not, having regard to the lapsing of the subsidy, or whether they should wait for the termination of the subsidy, and see then if any other offer could be obtained. On the opinion expressed by the shareholders must rest whether the negotiations were to go forward or to cease altogether. In answer to a question, he stated that the suggestion was not to give any dividend on the ordinary shares, but to buy them out and out, and as to the preference shareholders it was suggested that they should have a dividend of 3 per cent., payable to them on some debenture stock which should be considered good by the present board—a perpetual dividend of that amount.

The CHAIRMAN: It is a cash price for the ordinary shares and perpetual 3 per cent. dividend for the preference shares. That is the suggestion.

Dr. DEARLE supposed that the Government would not renew their subsidy.

The CHAIRMAN replied that they could not say. Their opinion was that the Government would be very foolish not to keep the Company's cable going, but one could not answer for the Treasury. He did not think they would get the same subsidy, though something might be given.

Mr. T. ADAMS thought that the shareholders ought to be much obliged to Mr. Robinson for the offer he had obtained, but it seemed to him a matter which ought to rest entirely with the board—that they ought to try and get some proposal which was tangible to bring before the shareholders and circulate among them, so that they might understand what the proposal was. There were a large number of shareholders not present at the meeting who had a large interest in the Company, and whose assent it was necessary to obtain. He thought that the shareholders might have sufficient confidence in the board to enable them to get a proposal which they themselves thought worthy of acceptance, and then for them to lay it before the shareholders at a special meeting. That seemed to him a business way of conducting an operation of this kind, as the shareholders could not know so well as the directors the prospective value of the property. If that met the views of Mr. Robinson and the board, it seemed to him the best way to proceed.

Dr. DEARLE thought it would be as well if the directors gave the shareholders their opinion on the subject.

The CHAIRMAN said it was so very difficult to give an opinion. The object rather in drawing the attention of the shareholders to the matter was to gather from those present whether they would like to take the terms suggested.

Dr. DEARLE thought they ought to have rather more than £2 10s. for the ordinary shares.

The CHAIRMAN said that that was his opinion, but if they went into serious negotiation on that basis with the other company, they would, to a certain extent, be compromised, and, perhaps, pledge themselves rather more than the shareholders would wish.

Dr. DEARLE thought that the better plan would be to request the directors to enter into direct negotiations with the other company.

The CHAIRMAN: And then bring the matter before you at a special meeting?

Dr. DEARLE: Yes.

The CHAIRMAN said it required a great deal not only of negotiation but also of manipulation. They would have to have two special meetings to alter their articles of association, as under them they had no power to sell their undertaking to another company. Their object on the present occasion was to try and find out whether the shareholders considered it advisable to accept anything like the offer suggested.

Mr. PONSONBY asked some preference shareholders to express their opinion.

A SHAREHOLDER thought that the directors should first enter into negotiations with the Government, as they might obtain an extension of the subsidy.

The CHAIRMAN said that they had been rather waiting for a favourable opportunity to communicate with the Government, and if the scheme referred to was proceeded with, they would have to go to the Government. They could not sell their subsidy without their permission. It might be that the time had arrived when they should go to the Government and say, Suppose we keep these lines open to Malta and Sicily, will you continue your guarantee, or shall we dispose of the undertaking to another company?

Dr. DEARLE thought that they had better leave the matter in the hands of the directors.

Mr. PONSONBY observed that if they went to the Government before the concession was out they would say, We will give you an answer by and bye. Still, there was no doubt that that was the time, if the shareholders requested them, when they could go to the Government and see if they would give the Company any terms, and then they could see what those terms would be.

Mr. MALLINSON supposed that the object of the directors was to ascertain whether the shareholders considered that the suggestion referred to was reasonable ["Hear, hear," from the chairman]. At the first blush he should think not, but he thought the shareholders were hardly sufficiently informed to express an opinion. He thought, therefore, that the matter should be left with the directors, on the distinct understanding that £2 10s. was too small for the ordinary shareholders.

A VOICE: And the 3 per cent. too.

Mr. VEARES regarded £2 10s. as an absurd price; he could get more by selling them in the market.

Dr. DEARLE moved that the matter be left entirely in the hands of the directors. The matter was so complicated that that would be the better course.

The CHAIRMAN: If I understand the matter, the feeling is that the directors should continue the negotiations, but certainly not enter into any arrangement that would engage your parting with your stock at £2 10s. We certainly should not conclude any arrangement without your consent, but you feel that we should not entertain any proposal to take £2 10s?

Dr. DEARLE replied that he would not say that they should entertain any proposal, but that they should negotiate.

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The CHAIRMAN: Quite so.

Mr. CLOTER asked whether it would not be advisable to continue the negotiations as they were now, but not to accept an offer till the Government subsidy expired.

The CHAIRMAN said they would make no undue haste in the matter, but see if they could not get a better proposal to lay before them, and meantime they would try and see what the Government proposed to do.

Mr. HIBBERT seconded the resolution, which was carried unanimously.

On the motion of the CHAIRMAN, seconded by Mr. PONSONBY, the retiring directors, Messrs. S. Gurney and C. H. Robinson, were re-elected, as were also the auditors, Messrs. Allwright and Hayward, on the motion of Mr. Veares.

Mr. ROBINSON returned thanks, and assured them that he would do all in his power to further the interests of the shareholders in the negotiations referred to.

The CHAIRMAN then moved, and Dr. DEARLE seconded, the payment of the dividends recommended, and the resolution was carried unanimously.

A vote of thanks to the chairman and directors was then passed on the motion of Mr. Veares, and

The CHAIRMAN having briefly acknowledged the compliment, the proceedings terminated.

UNITED TELEPHONE COMPANY (LIMITED).

A general meeting of this Company was held at the City Terminus Hotel, Cannon-street, on the 9th inst., "for the purpose of receiving, and if thought desirable, of adopting the report of the directors and the accounts for the year ending April 30th, 1881; also for the purpose of considering, and, if thought desirable, of sanctioning an agreement with Mr. C. H. Reed, of Sunderland, iron manufacturer, for granting to a company, intended to be formed under the name of 'The Northern District Telephone Company, Limited,' exclusive licenses for the use of the Company's patents in certain districts, partly in consideration of fully paid shares in such company, and partly in consideration of royalties; and in connection with such licenses to sell for fully paid shares and cash any business now carried on by the Company within the district comprised in such license, and any property used in such business." James Brand, Esq. (the chairman), presided.

The SECRETARY (Mr. Krause) having read the notice convening the meeting, the report of the directors was taken as read. It stated that the profit and loss account showed that the revenue of the company, from all sources, fairly attributable to the business of the year, amounted to £20,644. The expenditure properly chargeable against revenue amounted to £20,273, leaving a small balance of £370 as gain upon the working of the year's business. The profit and loss account had in the opinion of the directors been fully charged with all expenditure that ought to be brought against it, including the sum of £5,595 written off for the depreciation of plant, &c. Following upon the fusion of the Bell and Edison companies the two establishments had to be reorganised and brought into harmonious working, a uniform system had to be established, and means adopted to improve the conduct of the business taken over from the two companies. This involved much time, labour, and expense; and, besides, made it prudent to abstain from seeking new subscribers until the reasonable wants of the older ones could be fairly met. An abnormal relation between cost and income must result in the first year or two of such a business, a point specially to be borne in mind in judging of the future of the Company. As to their relations with the Post Office, the negotiations, which had been suspended during the legal proceedings, were re-opened, and a compromise was effected, based upon the Company's waiving their right of appeal and accepting the position of licensees of the Post Office, a course which seemed to be preferable to continued and costly litigation. An agreement upon this basis had been executed amd was now in operation. Under this the Company are to pay to the Post Office 10 per cent. of their gross receipts from all exchange business carried on within a radius of five miles of the General Post Office, London. They had to acknowledge that so far as their negotiations with the Department had already gone they had been met in a spirit of as enlightened liberality as could fairly be expected when it was remembered by what considerations the authorities must be hampered in their desire to protect the Post Office Telegraph monopoly acquired at so great a cost. But the board believed that experience would speedily prove the great superiority, for many purposes, of the telephone over the telegraph in facility of transmission, despatch, and economy, and that it must be soon largely employed by the Post Office itself as a useful and indispensable auxiliary to their important business. Having regard to the prospect that the payment of £100,000—half in cash and half in shares—coming from the Lancashire and Cheshire Company, would soon be in possession of the Company, and that no possible requirements would involve the expenditure of any large sum during the present year, the directors were of opinion that out of the cash received (£50,000), a payment to the shareholders, by way of bonus, should be made, and they suggested that £40,000 (equal to 10s. per share) might be returned on receipt of the cash portion of the purchase money, the balance of £10,000 being carried to a reserve fund, leaving the £50,000 of shares of the Lancashire Company, as well as the £225,000 of shares of the National Company, as an asset available for the general purposes of the Company.

The CHAIRMAN said: You have all read our report, and the figures of our balance-sheet are before you. I trust that they are not altogether unsatisfactory to you. We meet here to-day under pleasanter circumstances than when I last had the honour to address you. When our good ship was among the breakers we were surrounded by dangers on every side. Those to whom we had every right to look for help were among our bitterest foes, and did not scruple to accuse us of every wrong doing of which men are capable, including mismanagement of your affairs, and utter incapacity, and to prophesy the total collapse of ourselves and all our works. Now, however, these accusations are scattered to the winds by the results we have achieved, and the mismanagement and incapacity seem also to be a thing of the past. Collapse has given place to vigour, chaos is no more, and, thanks to the efforts of our indefatigable managing director (Mr. Joseph B. Morgan), order reigns supreme. Well, then, I think, under the circumstances, we are entitled to congratulate ourselves and you too. And considering the immense difficulties under which we have laboured—considering the entire novelty of our enterprise, and that we have had to feel our way at every step, considering that our progress was interfered with so long by internal differences, considering how difficult it is to get people to trouble themselves with any near thing, and, above all, that till very lately we have been hampered by our uncertain position with the Government, I think I may say that our development has been very remarkable. You must remember that we are a good deal ahead of what we are able to show. We have been plodding on, overcoming one difficulty after another—constructing our cables, and other matters requisite for meeting the increased requirements of the public, which I am glad to say are now pouring in upon us. I don't wish to bore you with figures, but I have here some statistics which have been compiled by the auditors, showing the increase in our subscriptions, the increase in the use of the instruments, and above all the decrease in the expenses on which all these results are achieved. For instance, in 1880, in May, June, and July, forty subscribers were connected together; the average number of calls—that is to say, the messages sent from one subscriber to another—during that time was 2·2 per subscriber per diem; and the total subscribers for the three months numbered 609. In August, September, and October, 1880, we connected up 101 subscribers; the average number of calls per day was 3·1, and the total number of subscribers had risen to 707. In November and December, 1880, and January, 1881, we connected with 113 subscribers, the calls rose to 4·15 per subscriber per diem, and the number of subscribers rose to 820. In February, March, and April (at that time we were arranging a fusion of our systems, and we had a great deal of trouble) the connections made were 96, the calls rose to 5·2 per subscriber per diem, and the number of subscribers was 916. In May, June, and July this year I am glad to tell you that we connected with 126 fresh subscribers; the calls rose to 6·1 per head per diem, and 1,052 subscribers were coupled up. We have now a great many orders on hand. I think I may say that our weekly expenditure for connecting this extra number of subscribers fell from about £350 in our worst times of small business and large expenses to £201, that is for doing the whole of that extra work. These statistics I think you will say speak for themselves. People who would have nothing to say to us, and who looked upon us as parcel of a unamiable enthusiasts amusing ourselves with a toy, now see the value of our telephones, come now to subscribe to our central offices of their own accord, and are only angry because we can't put them on quick enough. I would remind any one who is angry with us on that score that this is a very peculiar business, and requires great patience and caution in being carried out. We cannot march through every brick wall that we meet with; we should like to, but people will not have it. Hotels, clubs, and a great many of the principal tradespeople are now availing themselves of our services, and all we want now is that our shareholders should aid the directors in developing their own property. It is not possible for us to do everything. So far we have have had in London little or no help from our shareholders. I think we have about 650, and yet, as far as the London district is concerned, out of 1,100 subscribers you will be very much surprised to hear that only 25 are shareholders. I think this is hardly fair. You will by and by want, naturally, a dividend, but if you go on like this, and we do earn a dividend, it will be earned without any assistance from you. I feel sure that the telephone is taking up its proper position and becoming here, as it is in America, a necessity in the conduct of business. I think that the public are now taking us into their favour, and are satisfied that we are improving our position and our work and management very much indeed; and I feel sure that if you, gentlemen, will only do your fair share in furthering the interests of your own property, and earning a dividend for yourselves, you will not find any cause to complain of want of energy or care on the part of the board. As to the Lancashire and Cheshire Company, I dare say that some of you will remember that there was a good deal of illwill and anxiety expressed on the part of some shareholders at the last meeting. They thought we were not right in parting with our property in any part of the country. We pointed out that we parted with a portion of our rights to enable us to develop the scheme more rapidly and for the benefit of all concerned, and I am glad to say that the consequence has been that the Lancashire and Cheshire Company has been formed, of which we hold half the shares, in addition to their paying us a royalty on every instrument they use. The immediate consequence of that is that we are now about to receive very shortly a sum of £50,000 for the sale of half of our shares in that company, and we shall continue to retain as long as we think good the other half, which we consider worth £50,000 more. I see yesterday that the Consolidated Company held their first meeting, and as they are connected with us very closely, I am glad to bear out what was said by the chairman—that we are working in a very friendly spirit together, and on the condition that we gave them a contract for so many years to manufacture all the telephones we require, they took over and relieved us of all the rights which were said to belong to the agreement made with Messrs. Scott and Wollaston. I have no doubt that we shall continue to work pleasantly together; and from the increasing number of calls made on us for telephones for our own use and the use of our subsidiary companies, I have no doubt that we shall be able to give them a very large business indeed. I do not know that I have anything more to say now. If any gentleman would like to ask any question I shall be most delighted to answer him to the best of my ability. I now move—"That the report and balance sheet be adopted and entered on the minutes of the Company."

The DEPUTY CHAIRMAN (Mr. James Staats Forbes) seconded the motion, and observed that the chairman had placed everything so fully before them that there was nothing left for him (Mr. Forbes) to say. The whole of the directors were unanimous in recommending them to adopt the resolution proposed.

A short discussion then followed, which was taken part in by Messrs. Weir, Goddard, Durham, and Galsworthy.

The CHAIRMAN, in reply, stated that they constantly received intimation that there were infringements of their patents, but they generally found that there had been considerable exaggeration or misstatement, and it was very difficult to bring home to any one an infringement of their patents. The auditors would give every information concerning the accounts. They were making cables to enable them to reach different parts of the metropolis as soon as they could do so. Last week they connected 25 subscribers. They had now 74 exchange orders to execute, and 44 private; and the fact was that they were doing as much as they could. He thought they would have the town of Croydon coupled up very shortly. The Post Office were not interferring with them at all in London, and were carrying

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out very loyally what they promised, and would be glad to see the Company's exchange established as soon as they could do so. Mr. Galsworthy had alluded to the number of subscribers and the calls as showing the increased prosperity of the concern. He (the chairman) had given them the number of calls for subscribers per diem; but he thought they would be astonished to hear that on some days they reached over 7,000 messages a day on the small area they had at present coupled up. The Consolidated Company had cancelled the agreement of Messrs. Scott and Wollaston. The report was then adopted unanimously, and the bonus recommended was declared.

Subsequently resolutions were passed, re-electing the retiring directors, Messrs. Brand, Forbes, and J. H. Agnew. Reference was made to the great and unceasing exertions of Mr. Brand; and satisfaction was expressed at having such gentlemen as directors of the Company as Mr. Forbes (on account, among other reasons, of that gentleman's great railway connections) and Mr. Agnew. The auditors, Messrs. Quilter, Ball, and Co., and Messrs. Price, Waterhouse, and Co., were afterwards re-elected; and the agreement referred to with Mr. Reed was sanctioned.

Mr. GOWER then alluded to the decision recently given in the Circuit Court sitting at Massachusetts—a section of the Supreme Court, the highest tribunal in the country—that the patent of Mr. Bell carried even more than that gentleman and his friends had ever sought to claim for it. Thus out of the 400 odd patents before the Patent Office in America, not one would escape the obligation of paying a royalty to the great or final patent of Mr. Bell, which was this Company's property in this country.

A vote of thanks to the chairman and directors terminated the proceedings.

CONSOLIDATED TELEPHONE CONSTUCTION AND MAINTENANCE COMPANY (LIMITED).

The statutory general meeting of the Consolidated Telephone Construction and Maintenance Company (Limited) was held at the Cannon-street Hotel on the 8th inst., "to transact the ordinary business of the Company." Sir Julius Vogel, K.C.M.G. (the chairman of the Company), presided.

The SECRETARY (Mr. Charles Curtoys) having read the notice convening the meeting,

The CHAIRMAN said: Gentlemen, as you are aware, this is only an ordinary statutory meeting. There is, therefore, no business to be transacted, but it has occurred to the directors that you might like this opportunity to be taken to give you a general statement as to the position and prospects of the Company. If I am not trespassing too much on your attention, I propose to do so. In the first instance I may say that we have a very good list of shareholders—namely, over 700, which may be regarded as a considerable number for a company of this dimension. We have already established a factory. It was important to do so with the least possible delay; in fact, we have suffered from the want of instruments to carry out orders which we had to fulfil. We have, therefore, not made this factory on so large a scale as we shall probably have to adopt ultimately; but in the course of a week or two we shall be able to turn out a satisfactory number of telephones—100 to 200 a week, if not more. That has been of so much importance to us that to save time we had to give orders outside. I think I am not stating too much when I say that the position of this Company is a very strong one. First, we have, as you are aware, an agreement with the United Telephone Company, by which agreement they bind themselves, and the companies affiliated to them, to take all the instruments they require from us, at a very satisfactory rate of profit. The United Telephone Company, after a great deal of litigation and a great deal of negotiation, succeeded in securing in its own hands practically all the patents of value in this country, and although they may be from time to time subject to some litigation, I think practically that we may consider that their position is impregnable, and that they have really a monopoly of the telephone in the United Kingdom. We possess the sole right to supply them for a long term of years—twenty years, resolvable at the end of seven years on payment of a considerable sum of money; but there is no reason to think that the United Company will take advantage of that clause, and we may for all practical purposes consider that we have a very prolonged agreement. Independently of the agreement to supply them with all the instruments they require we are the sole licensees to make instruments for exportation. Outside our arrangement with the United Company we have to fulfil orders for a large number of instruments which we took over when we purchased the rights from Mr. Gower. Those orders will take a considerable time to execute, and it would not be advisable for me to say more than this, that they are orders of a very profitable nature. As I have said in respect to exporting, we have the sole right of making and selling for export in this country, and may therefore anticipate a large export business. We found, I am glad to say, when we came to look into the rights we had acquired, that we had patents as to business abroad which are more valuable than we anticipated. We put forth a company a short while since to work, in conjunction with Edison's people, our rights on the Continent. The company, however, decided not to allot the shares, as it was thought more desirable to withdraw it for the present, that further negotiations might take place with the view of further consolidation. As far as my own opinion is concerned I may say that I believe there will be as complete a consolidation of interests on the Continent as in America and as there is in this country, but such consolidation will take time to work out. We are doing our best to work in that direction. Whether we have to work our interests in Europe more or less in combination with others, or on the plan of a consolidation of all interests, or on our own behalf, I look on our interests in Europe as a valuable asset. We were also pleased to find that we possess in South America rights which may be of considerable value. There were concessions obtained in Buenos Ayres, Uruguay, and Paraguay, in which we had large interests, and in Buenos Ayres the affair promises to be particularly successful. We sent out some instruments, and there is a very urgent demand that we should send out a further considerable number; and, in fact, the matter seems so important that we have despatched a special representative to look after it and attend to it, in conjunction with the gentleman who has already established it. Well, gentlemen, I think I have told you in a short compass pretty well the nature of the position of our Company; and I may, perhaps, be allowed to say a few words with regard to the prospects of the telephone itself. In my opinion, the telephone in this country and in Europe—as, indeed, everywhere except in the United States—is in the very earliest infancy of its development. I think it will come into use as an article of necessary household use, as in the United States now, if I am well informed, and people will not only not hesitate about taking a single instrument into their houses but will have a number of instruments, and will find it necessary to do so. The plan of a great number of houses and business places in the United States is to have one telephone which the servants or clerks may look after in connection with exchanges, and, connected with that telephone, have other telephones which may be joined or disconnected with the main instrument. Then there is the necessary use of the instrument for many private purposes, apart from exchange purposes. Necessarily the development of this instrument is slow in this country, and it takes a long time sometimes to get the requisite permission for extending the wires. As to the importance of the instrument, the telephone, for business purposes, I think that the time has come when scarcely any one would be found to deny it. There is in this country rather a conservative feeling against any new adoption. I dare say some of us can remember when the use of the telegraph was looked on as a thing which would be of slow growth, and when we had no notion that it would enter into all sorts of daily and hourly purposes as has been the case. As to the telephone, very large and very small transactions may be carried on through its agency, and inasmuch as there is no separate charge for each separate message, there is no limit to its employment when arrangements have been made for its introduction. I may say, as an example of the use of the telephone, that I was speaking the other day to a solicitor, who told me that after some consideration he had introduced the telephone into his office. He said he hesitated to do so because he thought it would be very largely used, and might occasion considerable interruption in his business, but he added that he had applied to the Law Institution, and had been informed by that body that they thought it perfectly legitimate for a solicitor to charge for the use of the telephone as he would for other communications. The system was therefore adopted by him; and when you remember how many solicitors there are in London alone you may judge how many telephones might be made use of throughout the country. Lately I have received communications from various tradespeople saying that they have recently put their places in telephonic communication, and are prepared to receive orders by telephone. Well, we know what competition in this country is. When prominent tradespeople adopt that plan, it may be expected that it will be generally adopted; and I think it is only a question of time, and not a very long time, when the use of the telephone will be very general. The importance to us of an extended use of the instrument, seeing how very nearly we have a monopoly, needs no comment on my part; and, in fine, I may say that I consider we start with very excellent prospects before us, apart from those special interests to which I have referred. I see no reason why we have not the right to expect satisfactory and regular dividends from the Company in the ordinary progress of its business. As I have said to you, there is no special business to transact on this occasion, and I have to thank you for the kindness with which you have listened to the short statement I have made [applause]. If any gentleman has any question to ask I shall be glad to answer him, if I am able to do so.

In reply to Mr. EDWIN GALSWORTHY, who asked a question as to the right of the Company to the supply of telephones to the United Company,

The CHAIRMAN said: The nature of our agreement is that as regards a large number of instruments (over 20,000) we had the right to supply existing contracts direct. Otherwise for its use in this country we have the right to supply only through the United Company, which has the sole right of authorising the use of the instrument in the country. I should explain, perhaps, that there are various new companies—like the Lancashire and Cheshire and the National Companies, and so on. Those companies obtain their rights through the United Company, and one of the covenants is that they obtain their instruments from the United Company, who obtain their instruments through us. All the instruments used by the United Company or its affiliated companies are to be made by us [applause].

Mr. GALSWORTHY then moved a vote of thanks to the chairman, and in doing so observed that, as far as he could make out, there seemed very great prospects for the company.

A SHAREHOLDER seconded the motion, and it was carried unanimously.

The CHAIRMAN: Gentlemen, I am much obliged to you for your recognition of such services as I have been able to render you. The fact of your appreciation of any services I have rendered will be an incentive to my efforts in the future, and I am sure that I may say the same for my colleagues. We are all most anxious to make the Company a success, and we shall spare no pains to do so. We believe, and very strongly believe, that the Company will prove a most prosperous concern, and certainly it will not be the fault of the directors if it is otherwise.

The meeting then terminated.

TRAFFIC RECEIPTS FOR JULY, 1881.

COMPANIES.	July, 1881.	July, 1880.	Increase.	Decrse
Anglo-American Telegraph Company	£46,410	£19,500	£26,910	—
Brazilian Submarine Company.....	—	—	—	—
Cuba Submarine Company.....	2,492	2,915	—	423
Direct Spanish Telegraph Company	1,448	1,423	25	—
Direct United States Cable Company	15,470	6,500	8,970	—
Eastern Extension Telegraph Company	31,751	32,194	—	443
Eastern Telegraph Company	38,171	43,352	—	5,181
Great Northern Telegraph Company	22,400	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company..	—	—	—	—
West Coast of America Telegraph Company.	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—

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THE EASTERN TELEGRAPH COMPANY, LIMITED.

BOMBAY-ADEN CABLE REPAIRED AND RE-OPENED FOR TRAFFIC.

TELEGRAMS for INDIA, CHINA, JAVA, AUSTRALIA, and NEW ZEALAND accepted as usual at the Company's Offices :—

No. 11, OLD BROAD STREET,
No. 8, LEADENHALL STREET,
No. 3, GREAT TOWER STREET.

Telegrams sent from Postal Stations should be ordered

"VIA EASTERN."

66, Old Broad Street, London, August 10, 1881. GEORGE DRAPER, *Secretary.*

IMPORTANT TO TELEGRAPH COMPANIES.

THE SANITAS COMPANY (Limited), of Bethnal Green, E., have received the following gratifying letters upon the subject of Sanitas and its uses at Foreign Telegraph Stations:—

"THE MANAGING DIRECTOR, THE SANITAS COMPANY (LIMITED). "February 4th, 1880.
"We have now for more than a year been using your SANITAS soap and disinfectants in our ships, as well as at our stations, and find it greatly appreciated, more especially at tropical places, where the importance of sanitary arrangements is not well understood."

"London, 15th November, 1880.
"I think it right to inform you that our Superintendent at Mozambique says:—'I use the much-prized "SANITAS" freely, and feel perfectly safe wherever I sprinkle it.'" "JAMES ANDERSON, Managing Director, Eastern Telegraph Company (Limited), 66, Old Broad-street, E.C."

"SANITAS" DISINFECTING FLUID, No. 1, in 1/- and 2/6 bottles.
"SANITAS" DISINFECTING FLUID, No. 2, in 1/- pints.
"SANITAS" DISINFECTING OIL, @ 30/- per gallon.
"SANITAS" TOILET FLUID, in 1/- and 2/6 bottles.
"SANITAS" DISINFECTING POWDER, in 1/- boxes, and 17/6 per cwt.
"SANITAS" TOILET and NURSERY POWDER, in 1/- boxes.
"SANITAS" TOOTH POWDER, in 1/- boxes.

"SANITAS" DISINFECTING HARD SOAP, No. 1, in 6d. bars.
"SANITAS" DISINFECTING HARD SOAP, No. 2, in 4d. bars.
"SANITAS" SOFT SOAP, in 1/-, 1/9, 3/-, 5/-, 9/-, 12/6, and 1 24/- sizes.
"SANITAS" TOILET SOAP, in 1/6 boxes of three tablets.
"SANITAS" DISINFECTING FURNITURE CREAM, in 1/- bottles.
"SANITAS" DISINFECTING OINTMENT, in 1/- and 3/6 sizes.
"SANITAS" VETERINARY OINTMENT, in 2/6 tins.

SANITAS is Non-Poisonous and Without Stain, and is used by 400 Public Bodies.

THE SCHOOL OF SUBMARINE TELEGRAPHY & OF TELEPHONY.

ESTABLISHED IN 1868.

4, GEORGE STREET, HANOVER SQUARE, LONDON, W.

MANAGING DIRECTOR: Mr. T. J. JONES, M.S.T.E.

The course of Practical and Theoretical Instruction in the higher branches of Overland and Submarine Telegraphy embraces, in addition to the manipulation of the various systems of working in general use, the following subjects:—

MATHEMATICS, MECHANICS, and CHEMISTRY, } In relation to Telegraphy.

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ENGINEERING FORMULÆ and their Application in Practice.

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The instruction, both in signalling and testing, is of a thoroughly practical character, as the classes work with the actual instruments used on long lines, through cables of various lengths, from 600 to 3,000 knots, so that the signals of the Eastern, Atlantic, and Brazilian Co.'s, &c., are exactly reproduced, and the pupils fitted for any line.

A Course of Instruction in the Fitting up, working, and Testing of TELEPHONE CIRCUITS has now been added to, and embodied in, the ordinary curriculum, including all the forms of TELEPHONES, the various switch board arrangements and EXCHANGE SYSTEMS in general use.

Further information can be obtained on application to the SECRETARY.

TELEPHONE TRAINING SCHOOL, BEULAH-HILL, UPPER NORWOOD.—Under influential patronage.—A complete COURSE of PRACTICAL and SCIENTIFIC INSTRUCTION, with a view to future appointments.—For particulars, address THE PRINCIPAL, Telephone Training School, Beulah Hill, Upper Norwood.

FERD. CAPITAINE, Civil Engineer, 178, BOULEVARD VOLTAIRE, Paris.

Special attention given to every branch of applied electricity. Patents of Inventions applied for and worked on the Continent. Companies formed. Representation at Exhibitions. Commission Agent.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,

76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.

Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.

Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.

NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

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ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians,
86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.
pecialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manu-
facturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works,
IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited),
HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers,
MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia
Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER
WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

VULCANITE.

HARBURG INDIA-RUBBER COMB COMPANY.
LONDON WAREHOUSE: F. WINTER.
138, LONDON WALL, WOOD ST., E.C.

EBONITE.

DUNCAN WALLET & CO.,

BONDED STORE AND PROVISION MERCHANTS,

15, BILLITER STREET, LONDON.

Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

JOHNSON'S TRANSMITTER

(PATENT).

LOUD AND CLEAR. NO JARRING.
PERMANENT ADJUSTMENT.
NO OXIDATION. ONE LOCAL CELL.

TASKER, SONS & CO.,

ELECTRIC AND TELEPHONIC ENGINEERS,
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ELECTRIC LIGHT.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

ELECTRIC LIGHT.

THE ELECTRIC LIGHT and POWER GENERATOR COMPANY (Limited) are prepared to take orders for either the

INCANDESCENT LIGHT,

30 to 60 candle power (burning in vacuo), for domestic purposes, or the

ARC LIGHT

for Halls, Railway Stations, Streets, &c., &c.
Particulars, Price Lists, &c., by application to
The SECRETARY, 29, BANKSIDE, SOUTHWARK.

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BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

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A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

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Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

SOLE PATENTEES OF UNTWISTED WIRE ROPE.

Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c.

Gilt and Silver Cord for Hanging Pictures. Iron, Steel, and Copper Cord for Clock and Sash Lines, &c.

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SLIP

BARBADOES.—Cable communication between St. Vincent (West Indies) and Barbadoes is interrupted.

TELEGRAPH EXTENSION IN LANCASHIRE.—A new line of telegraph is to be erected from Manchester to Bolton.

KING KALAKUA.—The King of the Sandwich Islands paid a visit to the Electrical Exhibition at Paris last week.

ELECTRIC LIGHT FOR SWANSEA.—The Town Council are considering the question of adopting the electric light.

TELEPHONE LINE ACROSS THE HUDSON.—It is stated that a telephone cable has been laid across the Hudson River at New Hamburg.

ELECTRIC LIGHT IN NEW ZEALAND.—We hear that the *New Zealand Herald* office at Auckland is to be lighted by the Brush system.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this Company for the week ended 12th inst. amounted to £2,870.

THE ELECTRIC LIGHT AT MELBOURNE. — News from Australia says that the electric light is now used at the Alfred Graving Dock, Melbourne.

PRESIDENT GARFIELD AND THE NEW CABLE.—We learn that the first message sent over the new American cable was one of sympathy with President Garfield.

THUNDERSTORM IN LINCOLNSHIRE.—A severe thunderstorm passed over Lincolnshire and Yorkshire this week, considerable damage being done in places.

HONOURS FOR AN ELECTRICIAN.—*L'Electricité* announces that M. Bourseuil, optician, who invented the telephone, has just been decorated with the *légion d'honneur*.

ELECTRIC LIGHT FOR LIMERICK.—We hear that Messrs. Siemens Brothers have contracted with the Harbour Board of Limerick to light the docks by their system.

GREECE AND TURKEY.—A telegram from Constantinople, dated the 16th of August, says that a Commission has been appointed to determine the value of the telegraph lines in Thessally which are to be purchased by Greece.

THE TELEPHONE IN THE PROVINCES.—At a recent meeting of the Town Council of Derby the town clerk said that an experiment had been made with the telephone for three months, and it had been found to answer admirably.

THE SHETLAND CABLE.—From information received in Shetland it appears that the Government steamer for the repair of the cable between Shetland and Orkney has at length been despatched from London, and is expected at Lerwick in a day or two.

ELECTRIC LIGHT IN HOLLAND.—A correspondent writes from the Hague that electric lamps on Siemens' system have been lately installed at Utrecht and Rotterdam, and are working satisfactorily. Amsterdam also is said to be adopting the electric light largely.

NEW CABLES BETWEEN FRANCE AND ALGERIA.—*L'Electricité* says that the Minister of Posts and Telegraphs is thinking of laying two new cables to unite France with Algeria. The first will be between Bizerte and Ajaccio, and the second between Tunis and Marseilles.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this company for the week ending the 12th August, 1881, were £1,830, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

THE ELECTRICAL EXHIBITION.—News from Paris says that the technical committee of the Exhibition are about to organise a series of elementary lectures on some of the inventions exhibited. The grand display of electric lighting has been deferred till the end of the month.

ELECTRIC LIGHT IN SYDNEY.—Caterers for the amusement of the public in the Antipodes appear to be following the example of their cousins here, and are adding the electric light to their other attractions. We hear that a circus in Sydney has been illuminated by the electric light.

ELECTRIC LIGHT AT MERTHYR TYDVIL.—For the first time since these gatherings of Welshmen have been held the new light will illuminate their proceedings at the National Eisteddfod, to be held shortly at Merthyr. We believe the Brush Company have contracted to set up seven of their lights.

POST OFFICE TELEGRAPHS.—The twenty-seventh report of the Postmaster-General for the financial year ended the 31st March, 1881, has just been issued (Parliamentary Paper [C. 3,006-7]). It contains some interesting facts relating to the Post Office Telegraphs which we shall hope to find room for in another issue.

PRICES.—The prices as quoted are, for gutta percha, per lb., genuine, 4d. to 3s. 3d., reboiled, 3d. to 1s. 3d.; for india rubber, fine Para, 3s. 5d. to 3s. 5½d.; negrohead, 2s. 1d.; Central American, 1s. 7d. to 2s. 3d.; Assam and Pegu, 9d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 4d. to 2s. 2d.

ELECTRIC LIGHT IN SPAIN.—On the occasion of the recent journey of the King and Queen of Spain to Ferrol, the Marquis of Comillas entertained their Majesties at his country seat at Comillas. Amongst other attractions was a ball of peasants in Asturian costumes, the illumination of which was effected by ten electric lights.

ELECTRIC LIGHT IN LIVERPOOL.—The electric light was made use of this week in Liverpool to facilitate the laying down of the new tram lines by night as well as day. Owing to some accident, however, stated to be due to the temporary nature of the arrangements, the light had to be abandoned, and the work continued by the aid of gas and lanterns.

THE LATEST THING IN OVERHEAD WIRES.—We hear that the Telephone Despatch Company of Boston, U.S.A., has tried an experiment in aerial lines as follows:—A pipe of galvanised iron has been suspended from a strong strand, consisting of three large wires, for a long stretch of upwards of 500 feet, and in it were placed about 150 covered copper wires. The effect will no doubt be very striking some day.

OVERHEAD WIRES.—The Islington Vestry have just adopted a report from a committee appointed to consider their liability with regard to overhead wires, the substance of which is as follows:—That under the several Acts of Parliament relating to telegraph companies, and especially under the 22nd section of the Telegraph Act, 1863, local authorities are not responsible, and that the responsibility rests with the Postmaster-General.

THE AGGRIEVED TELEGRAPHISTS.—The long-deferred discussion on the revised scheme of pay for Postal Telegraph clerks took place in the House of Commons on Tuesday evening last, when a number of members advocated the cause of the clerks very warmly. The general upshot of the debate, however, was simply this, that the Postmaster-General adhered to his scheme, and obtained the money for carrying it out.

ELECTRIC LIGHT IN A COTTON MILL.—The Slaithwaite Spinning Company, whose works are situated at Slaithwaite, near Huddersfield, made trial of the Swan incandescent lamp last week, as a means of illuminating a new weaving shed.

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Five lights were used, worked by a Siemens dynamo machine, and a 4 h.-p. horizontal engine. The shed is said to have an area of 2,000 yards. The lights were well spoken of. It is probable that a further trial will be made before the light is finally adopted.

THUNDERSTORMS IN AUSTRIA.—Severe storms are reported from the neighbourhood of Vienna. It is stated that at Kornenburg the lightning three times in succession struck the large barracks now in process of erection, and knocked down forty men who were occupied on the spot. Of these it was found that two had been instantaneously killed, while ten others had received such injuries that they had to be conveyed home or into hospital. There were also twenty-five other men slightly injured.

UNCEREMONIOUS BEHAVIOUR OF THE ELECTRIC LIGHT.—To show, we suppose, that it is no respecter of persons, the electric light employed in the Vorarlberg Tunnel, now being constructed in the Tyrol, suddenly went out whilst the Emperor of Austria and party were inspecting the works, leaving them in utter darkness. The Emperor is said to have been highly amused by the occurrence. We are glad to say his Majesty was soon rescued by workmen with lamps, and we believe came out of the tunnel with whole shins.

UNDERGROUND WIRES IN NEW YORK.—The United States Underground Telegraph Company has laid an experimental series of seventy-two wires, extending from the head-quarters of the Fire Department in Mercer-street to police head-quarters in Mulberry-street. The wires are laid in long wooden boxes, covered with a preparation of silica and other substances designed to exclude dampness and secure perfect insulation. It is said that if the present experiment is successful the system will be extended, so as to include the police-stations, engine-houses, and fire-alarm boxes. They are also laying underground wires in Philadelphia.

SPONTANEOUS GALVANISATION OF AN ENGINE PISTON.—The *Révue Industrielle*, in a recent number, gives a curious instance of the spontaneous galvanisation of an engine piston, which took place at Cette, Hérault. The boiler having become much incrusted, some scraps of zinc were introduced to loosen the coating. Several days afterwards, the piston began to work with difficulty; when it was taken out, it was found to be covered with a thick coating of copper. This is supposed to have occurred from the particles of zinc carried with the steam into the copper steam-pipes forming a number of minute galvanic elements in combination with the copper; the vibration of the piston then attracted the copper molecules to itself, whilst the heat and the electric properties of the steam are considered to have facilitated their attachment to it.

"LIGHTNING CONDUCTORS."—"Experientia Docet" writes to the *Derby Mercury* under this head as follows:—"A short time since I had a lightning conductor erected. A London firm, recommended by an eminent architect, sent down their own man to fix it. I then had it tested by an electrician, who gave a formal report that the conductor was 'not only useless, but a positive source of danger.' In answer to my inquiries, the firm who erected it wrote me the various conditions necessary to make a conductor effective; several of these conditions had been entirely disregarded by their own workman. I beg to warn those who have conductors on their buildings, as it is quite possible they may be in ignorance on this matter." We hope "Experientia Docet" also knows that it is necessary to have conductors periodically tested to still further ensure the safety of buildings to which they are attached.

THE SANITARY EXHIBITION.—We append a list of the awards made by the judges on the electrical instruments and appliances exhibited at the International Sanitary Exhibition lately held at South Kensington Museum. A description of some of the apparatus exhibited was given in *The Electrician*, Vol. vii., No. 10, p. 151. The awards are as follow:—First class: James Coxeter and Son, for an improved manganese cell and other galvanic apparatus; J. B. Thistleton, special excellence in every kind of electrical apparatus. Awards of merit: India Rubber, Gutta Percha, and Telegraph Works Company, for Leclanché's medical battery, with conglomerate manganese plates; Krohne and Sesemann, for Stöhrer's (Dresden) medical battery and Leiter's (Vienna) galvano-cautery and electrical polyscope; Mayer and Meltzer, for galvanic apparatus and cautery; and John Weiss and Son, for galvanic batteries.

FIRED BY ELECTRICITY.—An interesting illustration of the danger attending the manufacture of some kinds of rubber goods was shown in the origin of the recent fire which occurred in the Ætna Rubber Mills, at Jamaica Plains. The cement which fastens the seams of rubber coats is largely made of naphtha. The mere act of lifting a piece of rubber cloth from a pile of half-a-dozen similar ones, cut for garments, developed so much electricity that a spark was observed to escape. It came in contact with the naphtha cement, or with gases arising from it, and instantly the whole room was in a blaze. Fortunately the fire was extinguished without destroying the mill, the loss being only about a thousand dollars. It is not known that anything can be done to prevent the occurrence of another accident of precisely the same kind whenever all the atmospheric conditions are favourable.—*Commercial Bulletin*, New York.

TELEPHONE POSTS.—In the House of Commons on the 12th instant, Mr. W. H. Smith asked the Attorney-General whether posts and wires erected for the purpose of conveying telephonic messages under the license of the Postmaster-General were under his charge; and whether it was the duty of the local authorities to see that no nuisance was created by the erection of such posts and wires, and that they were properly maintained. The Attorney-General was understood to say that no agreement had been entered into between the Postmaster-General and the telephone companies. The companies had no protection by statute, and were subject to the ordinary common liability. The duty of seeing that the public were protected against any nuisance would fall on the local authorities. Of course, if the Postmaster-General made any arrangement with the telephone companies he would take care that no inconvenience or injury should arise to the public.

WEATHER FORECASTS.—In the House of Commons one evening last week Major Nolan asked the Postmaster-General if he would direct that during harvest and sowing times the weather forecasts of the Meteorological Department should be published at those telegraph offices which were situated at places at more than two hours' distance from the office of publication of a daily paper. Mr. Fawcett reminded the house, that he answered a similar question upon this subject on Tuesday. He was unable, for the reasons then given, to comply with the request of the hon. and gallant member. Those weather forecasts might be supplied at a very small cost to villages and towns combining together for the purpose of obtaining the benefit of them. Mr. M. Henry asked whether Greenwich time was not telegraphed to the telegraph offices. Mr. Fawcett: Only for the information of the offices. When wanted for publication I believe these telegrams have to be paid for, but I will make inquiry.

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THE ELECTRICAL CONGRESS.—The Society of Telegraph Engineers and of Electricians has issued the following circular letter to its members:—"4, Broad Sanctuary, London, S.W., 10th August, 1881. Dear Sir: I beg to inform you that an extraordinary general meeting of the society will be held in Paris on Wednesday, the 21st of September next. As the arrangements for the meeting will depend to a great extent upon the number of members whose attendance will have to be provided for, I have to request the favour of your informing me as soon as possible whether you expect to be able to be present, and also whether you purpose submitting any paper which you would desire to be read upon the occasion, in which case the same should be forwarded to me at your earliest convenience, in order to enable the council to come to a decision thereon. Particulars as to where and at what hour the meeting is to be held will be obtainable by members on their arrival in Paris at the offices of the Royal British Commission, in the Palais des Champs Elysées.—(Signed) F. H. WEBB, Secretary."

LONG DISTANCE TELEPHONING.—The *Operator* says:—The telephone was successfully worked between Buffalo, N.Y., and Paterson, N.J., a distance of 350 miles. The series of experiments made were conducted by Mr. J. F. Noonan, Paterson Manager Metropolitan Telephone and Telegraph Company, who claims to have discovered a method of adjusting batteries so as to produce good results in communicating over long distances. Although the results of the test were not wholly satisfactory to Mr. Noonan, enough had been accomplished to show the value of his discoveries and to insure the possibility of long-distance telephoning. Listeners in the Buffalo Exchange could distinctly hear Mr. Noonan's "Halloa, Buffalo," and songs sung at Paterson were recognised at this end of the line. In talking, the voice could be plainly heard, but the words could not be distinguished amid the heavy sputtering and snapping noises caused by induction from the wires. Telephone men feel confident that, if a wire can be obtained remote from the wires devoted to telegraph business, conversation can be easily carried on under Noonan's method. As it was, the results of the experiments are considered of great practical value.

AMERICAN OPINION OF "MY LORDS."—The *Operator*, speaking of the recent Treasury minute with reference to the telegraph clerks' agitation, says:—"The British postal authorities, in reluctantly acceding to some of the demands of the operators, seem inclined to deny, with characteristic stupidity, the right of their *employés* to agitate any question of redress. The Government's last manifesto, after stating that 'my Lords accept the proposals which you submit to them for improving the pay and general position of the telegraphers and sorting clerks employed in the service of the Post Office in London and in the country,' proceeds [the *Operator* here quotes that portion of the minute forbidding future agitations]. Since our English professional brethren have made their point only by the power of their admirable organisation and discipline, it is not likely that they will be intimidated now by this threat on the part of Her Majesty's Government. They have proved that in union there is strength, and the Government in this remarkable document admits the strength of such a union, so that when the operators next have a grievance, it is rather too much to ask them not to resort to 'organised agitation.' The coolness of 'my Lords' is decidedly refreshing."

GAS LIGHT AND COKE COMPANY AND THE ELECTRIC LIGHT.—At the last meeting of this company the chairman (the Hon. R. Howe) said:—"The company had been perhaps somewhat affected by the aggregate of electric lighting in the City. He had never believed that the great difficulty the electric light had to overcome—the keeping up of a continuous light—could be altogether surmounted. He had seen the lighting in the City and on the Thames Embankment, and it fully confirmed his view that it could not be made continuous. As a proof of this he might mention that since its introduction in April the electric light had gone out in the City no less than 11 times; and this was not confined to one system of electricity, but was fairly distributed over the three companies now lighting the City, and on the Thames Embankment scarcely a night passed without some of the lights being extinguished." With regard to the latter part of this somewhat over-positive speech, the Société Générale d'Electricité write in contradiction of this statement:—"That since the 16th December, 1878, the night on which the Embankment was lighted by electricity for the first time, that thoroughfare has not been left once either in partial or total darkness through any failure of the electric light. On two occasions, once for a fortnight, once for a night, the electric lighting has had to be suspended altogether for alterations, in connection with two successive renewals of the contract with the Metropoliton Board of Works; but due notice had been given to the authorities and the public, so that the inconvenience, if any, had been reduced to a minimum."

TELEGRAPHS OF THE ARGENTINE REPUBLIC.—In the Reports of Her Majesty's Secretaries of Embassy and Legation, Part III. (Parliamentary Paper, No. [C—2,916], 1881), Mr. Egerton reports as follows on the Post Office and Telegraphs:—"Neither the Post Office nor Telegraph Department are as yet a source of revenue, the former in 1879 paying 92 per cent., the latter 94 per cent., of their respective expenses. This is a great advance, however, on previous years. In 1874, for instance, the Post Office only repaid 42 per cent., and the telegraphs 69 per cent., of their outgoings. The estimate in the Budget for 1880 for the two services was 525,000 hard dollars—375,000 for the Post Office and 150,000 for telegraphs. The telegraph rates having been raised to 40 centavos (about 1s. 7d.) for the first twenty words, and 20 centavos for each subsequent ten words, there has been some falling off in the number of messages since 1876, when 276,133 messages were sent. In 1879 there were 242,259, of which 42,636 were official, 141,179 commercial, and 58,444 personal. The total receipts from the telegraphs have increased, being 165,266 hard dollars in 1879, against 125,426 hard dollars in 1876. The expenses of the department were 166,276 hard dollars in 1876, and 169,266 dollars in 1879. The telegraphs ought to pay well; but, owing to neglect of necessary repairs, the lines, especially in the north and north-west, are constantly stopped working. Political changes impair the efficiency of these departments." We would particularly call attention to the fact that this is *Anno Domini* 1881, and considerably far advanced in that year, too, and that this report gives the figures for 1879 and the estimate for 1880.

THE GOVERNMENT AND THE ELECTRICAL EXHIBITION.—Commenting on the history and prospects of this Exhibition, the *Saturday Review* remarks:—"We are glad to say that Great Britain is fully and well represented; but, when we come to inquire into the history of the relations between the French Government and the English exhibitors, we have a feeling of shame as a nation and of pride in our countrymen. It is a story of the circumlocution office, full in official blindness to the importance of science, even in its applied form and even in discourtesy—unintentional, no doubt, but still

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discourtesy. About the end of December the French Government announced that the exhibition was to be held, and invited the English Government to appoint a commissioner to look after the interests of the English exhibitors; but it was not until the first week in March that the French authorities received an answer—a refusal to appoint commissioners on the ground of economy. But little time was left, as the last day for application for space was March 31. The Society of Telegraph Engineers and of Electricians at once formed a committee to undertake the duties of the English commissioners, and though the society is by no means wealthy they sent out circulars and succeeded in setting things going. Some time later the Society of Arts suggested to the Society of Telegraph Engineers and of Electricians that perhaps under pressure from the two bodies the Government might be induced to appoint unpaid commissioners, and after more delay England was at length put on the same footing as the other nations taking part in the Exhibition. It would be difficult to find men better suited for the purpose than the gentlemen chosen; they have carried the work forward with the utmost zeal and activity, and the result is that England will be thoroughly well represented at the Exhibition. But it is unpleasant to reflect that this result is mainly due to private bodies instead of State influence, and that such official recognition as English electricians have obtained is grudgingly and tardily given, and only on the condition that men shall be found to do the work entirely at their own expense, in spite of the fact that a Government department is one of the principal English exhibitors."

An Electric Lamplighter.—At a recent meeting of the Société d'Encouragement, &c., Colonel Sébert showed M. Gaiffe's electric lamplighter, which is to be used in the large shops of the Louvre. The apparatus for lighting instantaneously by means of electricity, which M. Gaiffe established in 1874, at the Assemblée Nationale, at Versailles, and later on, in 1879, at the Senate House in Paris, led him to the realisation of this new application of electricity. He had been commissioned in 1879 by the Messrs. Thévenot, cotton spinners, of Troyes, to make a lamplighter which should ignite the gas or other light by means of an electric spark, and this apparatus has been in constant use since that time. As regards the shops in the Louvre, the problem was to construct an electric lamplighter of equal or less weight than the ordinary one in which spirit is used, which should be worked by a handy portable battery, that should not interfere with the movements of the men, and should be sufficiently constant to permit of lighting a few burners during the morning, and as many as 150 lights in the evening, the cost of which should be small, and the total weight under 2 kilogrammes. M. Gaiffe solved this problem as follows:—He composed his battery of two small couples in square jars (6 centimetres on each side), such as he had constructed for medical purposes, electric bells, &c. These couples were formed of a porous carbon jar containing peroxide of manganese and a zinc cylinder. The cost is very small. The carbon porous jar, which serves as the collecting element in the couple, is closed by a simple stopper, which enables fresh peroxide of manganese to be put in without disturbing anything. These couples are enclosed in a copper box supported by a belt, and kept in place by a light band. The box carries two wires at one side, which are in connection with the two poles of the battery. The lamplighter is made of a pole furnished at the end with two pieces of brass, supporting a very fine platinum spiral. Copper wires, connected with the pieces of brass, are led down the pole, and end in flexible conductors which are connected with the battery. Two contact knobs, independent of each other, placed respectively at the bottom and middle of the pole, allow the circuit to be closed at will, and lights at different elevations to be illuminated. The working of the apparatus is very simple. The lamplighter carries the pole in his left hand and a key in his right; he opens the gascock with the key, presses with one of the fingers of his left hand on one of the contacts, and passes the platinum spiral, heated to incandescence by the electric current, above the globe of the burner, the gas at once lighting. M. Gaiffe's apparatus has, we are told, been in use at the shops in the Louvre for several weeks, and has now been definitely adopted by the authorities, who have decided to abolish the ordinary spirit lighters.

Edisonia.—The New York *Evening Post* gives the following account of what Edison is doing:—The Edison Electric Light Company has almost finished its work in its first district—that bounded by Nassau-street and the East River, Spruce and Wall streets—having already wired five hundred houses, and the number of men at work in the district has been reduced from eighty to forty. The eight hundred houses in the district will require about thirty thousand lamps. The mains are laid in most of the streets, and all that is needed to begin lighting by this system are the engines, which are promised by the middle of September. Mr. Edison expects that the first illumination by electricity upon a large scale will take place about the middle of October. The contract made between the Company and householder is that the new light shall cost no more than gas. As it is expected to be in every way superior to gas, there has been no hesitation in accepting the offer. The lighting up of this first district by electricity will be the signal, Mr. Edison thinks, for a general reduction of prices on the part of the gas companies, who can all afford to sell gas at one dollar a thousand feet and make a profit. For the last two months Mr. Edison has been busily at work upon what he is going to show at the Paris Exhibition of Electricity. Every outgoing French steamship carries a number of boxes full of machinery from Edison's workshops. One hundred and thirty-seven boxes left last week, and to-morrow's boat will take one hundred more. Mr. Batchelor, with eight assistants, has already left for Paris, where he will remain in charge of Edison's show rooms. Mr. E. H. Johnson will leave in a few days for London, where a model station, similar to the one at No. 165 Fifth-avenue, in this City, will be organised according to Edison's plans. The Edison lamp has not yet been properly exhibited in London. In Paris a license has been obtained from the municipal authorities authorising Edison to put up his lights wherever he may see fit, and it is thought that the exhibition of his light and power which he intends to make will create enough interest in the matter among Parisians to make it worth while organising a company for the sale of the light. Since the spring, a change has been made in the Edison lamp by which the lamps last an average of seven months instead of four, and one horse-power is sufficient for nine instead of seven lamps. The change consists in reducing the size of the carbon thread about one-fifth. Improved machinery has enabled Edison's men to do this without impairing the perfection of the thread. The Menlo Park factory is now turning out from nine hundred to eleven hundred lamps a day. In the up town districts laid out on the map by the Edison Company the canvassers are at work getting the householders to sign the contract authorising the Company to put in its wires. Major Eaton, the president of the Company, is confident that within a year every householder in the city can have gas or electric light according to taste.

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CORRESPONDENCE.

MOZAMBIQUE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: After a residence of two years in a small place like Mozambique one ought to be in possession of a little general knowledge of it, and I have thought that, perhaps, an even imperfect account of this slice of Portugal's East African colony, together with a few recollections, may prove interesting.

The island of Mozambique is separated from the mainland of Africa by a very good habour, the shortest distance across being about two miles. For vessels not drawing over eighteen feet of water very fair anchorage is to be found in the harbour. The current is remarkably strong, "running at the rate of knots." A navy captain compared it to a sluice. Boat sailing and rowing can be indulged in for quite seven months out of the twelve, and as boating constitutes our chief means of recreation I need hardly say that we are grateful. I do not think it can be said that we have abused our opportunities. Sharks are very numerous in the harbour, and much too often they succeed in getting human victims. Yet, despite the frequent accidents, the black people will venture into the water. Batches of seven or eight women are to be seen day after day fishing. They wade sometimes up to their shoulders. Four of them carry a four-cornered net, one carries the basket, while the others act as "beaters" a little distance off. When they see a fish they surround it and close upon it until the bewildered thing finds itself entangled in the meshes of the fishing net. They say that, so long as one keeps on splashing the water about, the sharks, being cowards, will not approach. This fact is evidently known to the "seedy boy" who jumped on top of the shark while it was tearing off the leg of his shipmate in this harbour. It is a matter of great wonder to me that the canoes plying between this and the mainland manage to cross with so much safety. They are made of the bark of trees, the strips of bark being sewn together with coir-yarn. Sometimes one whole piece of bark makes a complete boat, and in these tiny, frail crafts, the natives think nothing of paddling or sailing across four or five miles of rough water. For sailing they doff themselves of the pieces of cloth they wear, hoist them between two bamboo canes, and sail away. There is a great deal of traffic between Mussoril, Cabaceira Grande and Cabaceira Pequena, on the mainland, and the island of Mozambique, both for passengers and merchandise. We depend entirely upon the mainland for our daily supplies of food. The oxen, ducks, fowls, vegetables, &c., come chiefly from Mussoril, and it is a pretty sight to see the market boats, twenty to thirty in number, emerging from the Mussoril Creek in the early morn, and sailing towards us like so many gigantic white-winged birds. I have often watched them when the rays of the rising sun have lent to their large lateen sails that snowy whiteness which helps to make such a grand picture of a full-rigged ship at sea. The beautifully green water in front of them, the blue outline of the coast behind them, all fresh in the awakening morn—a worthy subject for an artist, truly. These market-boats are favoured with a morning land-breeze all the year round, and by it they are wafted, more or less, gently across to Mozambique.

The town of Mozambique is creditably clean; the streets are wide and well looked after; the houses, generally speaking, are roomy and airy; the sanitary arrangements are not quite as good as they should be. The Governor-General's palace, the Custom House, the Town Hall, and various other Government buildings, are substantial and serviceable enough. During the past two years a spacious new cemetery has been opened; and a new general market, a new fish market, together with some smaller buildings, have been erected. There is in course of construction a magnificent hospital, which, when completed, will, in all conscience, be large enough. Most people here regard this building with disfavour, it being more suitable for the capital of Portugal than for the capital of this province. The plans reminded me very much of St. Thomas's Hospital, Westminster.

Fort San Sebastian forms the centre of attraction on account of its size, construction, and adaptability. It was built over two and a half centuries ago, when the Portuguese nation was in the zenith of its glory—when the performances of its great navigators were mingled with the daily thoughts of Portugal's sons, stirring them to the accomplishment of further deeds of renown.

While other edifices of those days have long since become ruins this grand old fortress remains intact as a memorial of the bygone glories of the nation. During the eighteenth century slave-trading is said to have been very brisk and remunerative, hence the numerous ruins of houses—mansions even—which one sees on the mainland. Such buildings are not erected in the province nowadays. Untenanted, uncared-for, fast crumbling into dust, surrounded by a labyrinth of weeds, intermingled with the richest herbage, their gables towering high—these mansions of old stand. Over them, see the stately palm-trees, with their graceful leaves bending and waving mournfully in the breeze, and listen to the weird music caused by the rustling of the leaves—an appropriate requiem for the fame that is dead.

The island of Mozambique is, as near as possible, a mile and three-quarters in length by half a mile wide at its widest limit. The European community occupies the northern end, the Indian the centre, and the native the southern end of the island. This is approximate. A good road runs from one extremity to the other, and finishes in two very fine avenues. The island is a simple coral reef, and in one part the coral is quarried and burnt in lime kilns. It makes good lime. It is supposed that the disintegration of this coral—flooded by the rains that are subsequently absorbed by the heat—fills the atmosphere with that miasma which causes fever.

In front of the palace there is a music pavilion, where the band plays twice a week. We have also a very fair club here.

The establishment of telegraphic communication between Europe and Eastern and Southern Africa was one of the most important benefits bestowed upon commerce and governments in the year 1879, and its successful achievement should be heralded down to posterity in the annals of at least England and South Africa. Submerged during the heat of the Zulu war, the cables became at once the grand medium for conveying news of the successes and losses of that war. Since then how beneficial they proved to be whilst our conflicts were raging with Basuto and Boer.

The Mozambique staff arrived here on the 26th June, 1879, just two years ago. At that time there was an hotel here, and until we found a vacant house we were obliged to stay at that so-called hotel. It has since been abandoned, and humanity has profited thereby. Very fortunately there was an empty house not far from the fort, and I immediately commenced negotiations with its owner. After considerable haggling over the rent we at last came to terms. When a couple of mattresses and some blankets had been unpacked, I determined to sleep in the house for the first time. The clerk in charge insisted upon accompanying me. We hired a black boy, who made our beds on the floor, and who then went to rest outside our bed room door. With the darkness came dark forebodings. The house stood apart from all others amidst trees which cast ominous shadows and deepened the darkness round about. We were strangers on a little island. Within six hundred yards of us were a lot of ruffianly convicts. Who knew but that some of them might have been lurking near our habitation at that very moment. Ah, how carefully we barred the doors and windows after casting furtive glances outside. Then the minute examination of my revolver charges ere I placed the weapon under my pillow that night. Yet I could not sleep; there were peculiar noises in the house. I am not brave, consequently it took me a long time to muster courage enough to resolve upon an investigasion of the cause. My companion was snoring. At length I got up, and, revolver in hand, groped my way in the direction of the door. I found it, and was steadily moving along, when I stumbled and fell over some object. Then the stillness of the night was broken by the audible palpitations of my heart, and by a still more audible breath which the object beneath me drew. Yes, it was the black boy. I gathered together

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my fast waning courage, and retraced my steps. I laid me down once more, and after communing mentally with myself, I became a calmer and a wiser man. In a few minutes I fell asleep.

When the morning sun had dispersed the terror-freighted darkness of that night we searched the house, and in one of the rooms found a very wild cat.

A little time rolled by and the same house was made the Eastern and South African Telegraph Company's Station. It at once became noted, and half the population of the island craved permission to see the instruments, specimens of the cables, &c. One of the sheiks from the Makuah country became so persistently constant in his visits that, at last, I was obliged to refuse him further admission. He used to present himself, followed by a retinue of six or seven persons, and after obtaining the necessary permission to enter, he would sit down in front of a Morse instrument. When the clockwork was set in motion, and he heard the buzz which the fan sometimes creates, the old sheik would lift up his hands in amazement, and utter a prolonged "Coo-oo-oo!" Goodness knows what his conjectures were upon those occasions. "Coo!" is an expression very frequently used by the Makuahs, and, in one of its many phases, it denotes admiration or surprise. I have heard them also, in talking of a place a long way off, prolong the "long way" in proportion to the distance. In time one ought to be able to judge the distances by the length of their utterances, especially if, after the style of the hand-log on board ship, the utterances were proportionately measured off into knots. To return to the sheik. Great was his astonishment when he saw the "slip" running out. He could not make out where on earth it came from, and when I caused the armature to click by means of the relay, the old man would hurriedly get up and increase the distance between him and the instrument. On being assured that there was no danger, he would take a piece of the slip and carefully place it in his gold-braided waistcoat pocket. I was always glad when he made his salaams and retired, but the merry twinkle to be seen in his eye "spoke" of another visit when he came across to Mozambique again.

Telegraphy has caused a gradual increase in the trade of this province, and it has been the means of distributing amongst the many that monopoly which, before its advent, was enjoyed by the few. There are three or four very good European and several Indian houses of business in Mozambique. They all make free use of cable communication. We are now in the dull season, when trade is naturally very slack. Another month or two will witness a stir. Dhow after dhow will arrive laden with produce; the records of the Custom House will show a marked increase in imports and exports; and, like a giant (on a small scale) refreshed, Mozambique will, with tucked-up sleeves, be busy. Telegraphy stimulates activity—it is such a tell-tale. Once upon a time the market prices in Europe and India were *first* known by the favoured few. Now, one merchant can be as well "posted" as his neighbour, on the same day and in the same hour if he chooses. Thus an amount of tact has to be resorted to in dealing nowadays which was not necessary before. The Banians and Hindees are said to be very shrewd business people. They consider it their bounden duty to bargain, and for a long time they could not understand why we never "took off" even a penny on a telegram. They smiled knowingly when we showed them the printed tariff lists, and by those "knowing smiles" they simply meant, "That's all very well. You can take off a trifle if you like. At all events *we mean to try you!*" Thank goodness they know better now. Bargaining is a most uncomfortable performance.

It is pretty generally known that the East African climate is not healthy. The "baneful mangroves," getting wet, &c., are things to be avoided as much as possible in Mozambique. Another bugbear is the food we should eat; and as I have a formidable opponent in the British Consul, I am almost afraid to put forth my opinion on this point in writing. My friend advocates dieting oneself, whereas I advocate eating a solid beef steak once or twice a day. By "dieting" is meant eating light food, such as chicken, cutlets, rice, &c. After my short experience of this climate I have arrived at the conclusion that the system is bound to be nourished with fresh meat and good, blood-making wine every day. These two nutriments prevent that deterioration of the blood which is so often witnessed in people here, and which renders their systems incapable of coping with attacks of fever. To substantial nourishment must be added muscular exercise, without which the liver becomes sluggish, and, as is well known, sluggishness of that important member leads to other complaints the seriousness of which cannot be too indelibly impressed upon peoples' minds.

A more able pen than mine could, without doubt, have made this short summary interesting. I have written it hurriedly on the eve of my departure for Zanzibar, but with leisure time I do not think I could improve upon it very markedly.

Before concluding I must confess that I leave Mozambique—the seat of my labours for two years—with a twinge of regret. I have been very comfortable in the house purchased and furnished by the Company at great expense; and I sincerely hope that my successor will be equally as comfortable, and that he, together with his staff, will enjoy good health.—Yours, &c.,

D.

"WHAT IS ELECTRICITY?"

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I have read with much interest in your number of the 13th current the translation of an abstract by M. Holtz "On the Condition of Flames under the Influence of Electricity." It affords an excellent opportunity of showing the absurdity of using the terms positive and negative in the sense of there being two kinds of electricity or two different electric forces as propounded by Faraday.

According to the abstract, "When charged with positive electricity the flame became more blue, narrower, and pointed at the top, while little or nothing of this result was observed in negative flames. A peculiar result is that the end of a negative flame returns to its own conductor, and that according to the intensity of the electricity." Again it is written:—"Why, principally, the negative flame returns may be explained in two ways—either the point of the flame loses much by radiation or the base of the flame is a bad conductor." These reasons are a delusion. The gas flame in each case was placed on a frictional electrical machine, so that the whole flame was electrified throughout its length. When the flame was placed on the part of the machine which is said to give out positive electricity, the truth is that the electric current was then rushing along the course of the flame from the bottom to the top of it, and hence it tended to increase the length of the flame, and diminish its width. But when the flame was placed on the part of the machine which is said to give out negative electricity, the flame instead of lengthening upwards was dashed downwards, especially the top or point of the flame. This arose from the fact that the current of electricity rushes from the direction of the top or point of the flame down towards the bottom of it, and into the electrical machine. If M. Holtz had understood that that which he calls positive electricity is merely the rushing of the electric current out of the machine, and that which he calls negative electricity is merely the rushing of the electric current into the machine, he would not have written the strange assertion that the "negative flame returns [that is to say, is flattened down], owing to the point of the flame losing much by radiation." He was trying to give a reason for a phenomenon he did not understand because his mind was biassed against the truth regarding the facts he witnessed, and owing to his believing in the existence of two electricities instead of the fact that there is only one.

The object M. Holtz had in making these experiments was very different from that I had in view when making my experiments on gas flame in 1839. At that early date I had become convinced that there is only one electricity, and that it was an error in the books of that time asserting that one kind of electricity was given out by the prime conductor of an electrical machine, while another kind of electricity was given out at the cushion end of the machine. This made me search for some substance which would bend to a current of

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electricity and indicate the direction in which the current was moving, and thereby enable me to demonstrate that a current of electricity went in at the cushion end of the machine, while a current of electricity came out at the prime conductor end. After many trials I found that an insulated flame of coal gas answered this purpose. Although I published these results at that date electricians would not give heed to these facts, which demonstrate that there is only one electricity. Hence we had in your pages Mr. Gordon's statement that "if he knew in which direction any current of electricity flows he should have no need to ask 'What is electricity?'" And we have had Professor Fleeming Jenkin's statement about electricity being a neutral fluid divisable into two fluids, positive and negative. And, again, we have had in your pages a letter from Mr. Sam. E. Phillips, who has given a very indistinct statement of what he means, but, as far as I can understand him, his object is to maintain that some electrical phenomena apparently show a "duality of effects," and although he believes there is only one electricity, yet he considers electricians are justified in describing these apparent "duality of effects" by the theory of two electricities, until they have discovered how these effects coincide with the fact that there is only one electricity. Now I hold that this is wrong. It is far better for an electrician to acknowledge that he does not understand a given electrical phenomenon than to attempt an explanation of it such as M. Holtz has given of the action of electrified flame. If I have misunderstood Mr. Phillips, then he will, perhaps, be so good as to take a frictional electrical machine as his guide, and show in which part of its action a "duality of effects" take place, which cannot be explained in accordance with the fact of there being only one electricity.—Yours, &c.,

JAMES JOHNSTONE.

Experiment Rooms, 1, James-square, Edinburgh,
August 15, 1881.

CANTOR LECTURES.*

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

BY PROFESSOR W. GRYLLS ADAMS, F.R.S.

LECTURE I.—DELIVERED MONDAY, MARCH 7, 1881.

The Production and Regulation of Electric Currents.—The Laws of the Mutual Induction of Currents and Magnets.

It has been well said that rarely does a great discovery, as soon as it is made, at once begin to furnish the results which follow as a natural consequence from it. Nearly all important discoveries pass through a stage of neglect or obscurity. Either the public attention is already pre-occupied, or the discoveries come at a time when the public are not prepared for them, and they are disregarded, and may even disappear with their authors for a time, to come forward again with fresh force in after years, when the world is more in tune to receive them. Sometimes they pass through a stage of quiet development in the laboratory; laws are established, apparatus is devised to prove them, attention is drawn to them, public spirit is awakened, and from the higher level of the great discoverer flow new facts and new inventions, with astonishing rapidity, in many channels; the potential energy of the discoverer is transformed into energy of action in many directions, with more or less efficiency, according to the retarding state of the medium through which that action takes place.

The progress of electrical science in its several branches will afford abundant instances of these several stages. If, for instance, we regard the progress of telegraphy, we find that Sir Francis Ronalds, in 1816, showed that electricity could be practically used for conveying messages over long distances; yet so little notice is taken of his discoveries by the public and by the Government, who were no longer in need (so they said) of telegraphs after the battle of Waterloo, that he is almost driven to despair, and speaks of "taking leave of a science which once afforded him a favourite source of amusement," and of "bidding a cordial adieu to electricity."

It is remarkable that he should have said sixty years ago, "Let us have electrical conversation offices communicating with each other all over the kingdom," and yet the electric telegraph was not established until twenty years after (1837), and we are only now arriving at the system of telephonic exchanges.

In a private letter, written on his 72nd birthday, in 1860, he says, "If the electric telegraph of 1816 had been fairly examined, an effective instrument might have been in the hands of the Government, and after Dr. Oersted's experiments (in 1820) an improved telegraph might have been in their hands."

We shall also see other instances in connection with the special subject of my lectures, in which discoveries are neglected and passed by, because, as we say, the discoverers were men who were in advance of their time, and in some cases the same discoveries are again made, and become known under another name. In 1815, Sir Francis Ronalds constructed an electric engine, which was set in motion by means of Singer's electric columns, and as late as 1851 this engine was still in working order, when it was, I believe, at the Kew Observatory.

In 1813, *i.e.*, when Ronalds was experimenting on the electric telegraph at Hammersmith, by means of his registering pith-ball electrometers, Sir Humphry Davy produced the electric light between two carbons, which were joined to the two poles of a powerful battery.

The following is a description of Sir Humphry Davy's experiments with the electric light:—

"Mr. Pepys having had the goodness to charge the great battery of the London Institution, consisting of 2,000 double plates of zinc and copper, with a mixture of 1,168 parts of water, 108 parts of nitrous acid, and 25 parts of sulphuric acid, so as to make an arc or column of electric light, varying in length from one to four inches, according to the state of rarefaction of the atmosphere in which it was produced, and a powerful magnet being presented to this arc or column, having its pole at a very acute angle to it, the arc or column was attracted or repelled with a rotatory motion, or made to revolve, by placing the pole in different positions, being repelled when the negative pole was on the right hand by the north pole of the magnet, and attracted by the south pole."

With a few cells of some of the more powerful batteries, such as Grove's, or Bunsen's, or the bichromate of potash battery, we may readily reproduce the celebrated experiment of Sir Humphry Davy.

When Davy discovered the electric light in 1813, little was known of voltaic electricity, except that the current decomposed salts, and was always accompanied by chemical action in the battery. Davy had obtained the metals potassium, sodium, barium, strontium, calcium, and magnesium by the electric current. The relation between electricity and magnetism was still unknown.

In the year 1820, Oersted first observed the action of a current of electricity on the magnetic needles, and thus gave a ready method of comparing the effects of different currents, by balancing these effects on the needles against the effect of the earth's horizontal magnetic force. In the same year Ampère discovered the law of the action of the current on the magnetic needles, and propounded his celebrated theory of magnets and of terrestrial magnetism. According to this theory, every particle of a piece of steel which forms the magnet has currents of electricity circulating round it in the same direction, and the magnetism of the magnet is only the resultant action of all these currents taken through the whole of the piece of steel. Thus magnetism is the resultant action of electric currents.

Ampère's experiments (which were repeated in the lecture) showed the mutual attraction and repulsion of parallel currents, and of currents and magnets; also that a current in a solenoid or in a flat coil, acts as a magnet; and that a hollow coil carrying a current attracts a core of soft iron and holds it up.

These elementary experiments are now very simple, and they may be very well known; but, as we shall see in the lectures which are to follow, some of these early and simple devices are found to be among the most efficient for controlling and regulating the current and steadying the light in some of the best electric lamps. Whilst Ampère was developing Oersted's experiment in one direction, Schweigger in the same year (1820) employed it for the comparison of currents, and invented the galvanometer. Then followed improved galvanometers by Becquerel and others; and in 1827, Ohm gave his simple theory of the action of batteries which was deduced from Volta's principle, and this has formed the groundwork of all later investigations of the subject.

If we consider these simple experiments of Oersted and Ampère in their relation to the now well-established principles of conservation of energy, we may arrive at some important conclusions which again are fully borne out by experiment. Thus, when a current of electricity passes along a wire in Oersted's experiment, part of its energy is spent in overcoming the resistance of the wire, and another part is spent in causing the motion of the magnetic needle, *i.e.*, in doing work upon it in opposition to the pull of the magnetic force of the earth upon it.

(TO BE CONTINUED.)

* Reprinted from the *Journal* of the Society of Arts for August, 1881.

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THE ELECTRICIAN.

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BROOKS' SYSTEM OF INSULATION.

Amongst the many indispensable adjuncts of the electric telegraph perhaps none have undergone so little improvement as the "insulator." The material of which it is composed has been improved, and its construction varied in manifold ways, to adapt it to the several conditions under which it is employed. Nevertheless, a collection of insulators, antiquated or modern, suggest many reflections besides curiosity, and many that are the reverse of complimentary, the most recent specimen being notable chiefly for its being the most expensive. In no other respect has there been any strikingly new departure from the original principle on which the insulating holder was constructed; indeed, in some respects it might be argued that what has been gained in design has been lost in convenience, the most elaborately perfect combination to prevent leakage offering the greatest harbourage for cobwebs and dirt. It has been grimly observed that insulators would be excellent things if only they could be insulated. Perhaps the nearst approach to a device which indirectly attained this object was that of filling the cup with oil; but it is too soon yet to say whether in practice that form of insulator will fulfil all that was predicted for it at the time.

The multiplication of new land lines, and the necessity which has arisen for replacing old lines, have lately caused much attention to be directed to the possibilities of substituting underground wires for aerial wires on some principle that shall be permanent in construction and efficient as regards insulation. In Germany this has already been done over considerable tracks of country, and in England probably the next move will be in that direction. But it is to the introduction of the telephone that we shall probably owe the greatest improvements. That system, more than any other, demands, if not perfect insulation, practical freedom from induction. Moreover, as we have repeatedly pointed out, the area of telephonic operations lying chiefly in populous towns, the increase of overhead wires will very speedily be forbidden. At this juncture, therefore, it is with much satisfaction that we notice a very promising attempt to overcome at one stroke all the objections to an underground system of telegraphy, at any rate for comparatively short lengths, such as those commonly needed for telephonic signalling. Mr. Brooks's system combines the advantages of permanency, cheapness, and what is of great importance, compactness, together with insulation which, so far as it has been tried in this country, seems to be satisfactory and practically unvarying. Instead of cumbrous cables of gutta percha-covered wires, requiring pipes of large dimensions and affording little protection from leakage, and none whatever from induction, Mr. Brooks simply covers his wires each with a wrapping of jute to prevent actual contact, binds them together cablewise, draws them into pipes, which are screwed at the joints, and are then filled with liquid petroleum. It is obvious that this arrangement admits of the wires being exceptionally fine, and the pipes of very small calibre; indeed, it is stated that as many as 300 such telephone wires can be placed in a tube of only an inch and a quarter diameter. Lodged in this non-conducting mineral oil, the wires are secure from most of the causes of deterioration which affect ordinary underground cores—the insidious action of oxygen and the decay due to vegetable and animal organisms being absolutely set at defiance. Short lengths of this system have been tried by the Post Office on the South Western line with results which we published in our issue of the 6th inst. The uniformity both as regards inductivity and insulation has proved to be very remarkable. The electrostatic capacity, it is true, is somewhat greater than that of our ordinary telegraph cables, and it would be a mistake therefore to suppose that the evils of inductive retardation can be entirely overcome by this method of construction. But this shortcoming, and the absence of any very high degree of insulation resistance, would in ordinary cases be amply compensated for by the security, durability, cheapness and constancy which already may be said to characterise Mr. Brooks's system.

The possibility, therefore, of laying down a sufficiency of wire accommodation for the growing needs of telephonic communication becomes at once apparent with such a system as this at our disposal. Several thousand wires could be securely housed in a tube of three or four inches diameter; and these, carried from a central office along the main routes, could be tapped again in any direction required. The cost of laying down such tubes anywhere would be comparatively small, and in London particularly, on account of the various underground railroads, facilities already exist which the railway companies would probably not be unwilling to afford. The telephone is yet in its infancy; if it is to be allowed free development for its natural growth, some alternative must be found for the alarming and unsatisfactory system of housetop wires. The method patented by Mr. Brooks, and exhibited in Paris just now by the Silvertown India Rubber Company, is the best alternative yet suggested,

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and is probably the one which, with some modification, will ultimately prevail.

It is legitimately claimed for this invention that for ordinary telegraphic purposes it is far superior to an aerial system of poles and insulators. The work of reconstruction must necessarily be slow on a gigantic system such as exists already in this country; but if, as is alleged, a low constant insulation is preferable for the working of land lines, the immunity from the vicissitudes of weather, and the indestructibility of the materials employed, will sooner or later open for this latest mode of insulation a very wide field indeed. For electric lighting purposes, too, it is not unlikely that it may prove useful; since it is by no means certain that the employment of a low electromotive force acting through a low resistance, which hitherto has been generally favoured, will give place to the contrary conditions involving high tensions, and of which the possible theoretical advantages are attended with several practical dangers. And in most cases where currents are generated under a low tension, their insulation by Mr. Brooks's system might be attended with advantage. What the behaviour of the petroleum would be if subjected to the conditions for electrolysis, with a very high difference of potential between the wire and pipe electrodes, we have no practical evidence to show; but we assume that it is not intended to apply the system in cases where the electromotive force would be very much higher than that ordinarily used in telegraphy. At all events, we have now an insulator which, under ordinary conditions, is, so far as we know, practically unchangeable; and as it neither attacks the coating of the wires nor is itself attacked, whilst it is low in cost and electrically impervious to a sufficient degree, we are glad to welcome it as the boldest and most valuable suggestion that has ever been made since "insulators" were first invented.

THERE'S MUCH VIRTUE IN AN "IF."—The following letter appeared in the *Operator* of the 1st of August:—"Sir: I notice an article in your last issue by W. H. Preece, on 'Recent Advances in Electric Lighting.' He says that Sir William Armstrong can only keep thirty-seven lamps going, Lane Fox could only show twelve lights, Professor Adams could only produce from the most powerful dynamo-electric machine by calculation 140. It seems to me that if the dynamo-electric machines were multiplied on one conductor, with their poles properly arranged, this would solve the difficulty. That is to say, if fifty machines were placed on a conductor large enough, the result would be—taking the 100 light machine as a standard—that we would get 5,000 lights from it. If this holds good, then the only limit would be the power of the steam engine driving the machines and the size of the conductor.—OLD LINER, New York."

LEGAL.—PERRY V. THE INTERNATIONAL OCEAN TELEGRAPH COMPANY AND OTHERS.—Judgment was delivered a few days ago in this case, which was opened on the 16th June, and argued during several following days. Mr. Horatio Justin Perry, of Lisbon, claimed a moiety of a sum of £50,000 stock of the West India Company, and of the profits made by the first defendants, the International Company, under certain contracts for the through working of the telegraph lines and cables of the West India Company in connection with the International Company. The defendants denied Mr. Perry's claims, and the Vice-Chancellor, after an elaborate review of the claim, defences, pleadings, and evidence, gave judgment for the defendants, and dismissed the plaintiff's bill with costs.

JAMAICA TELEGRAPHS.—News from this island says that further extensions of the telegraph system have been authorised.

THE ELECTRICAL EXHIBITION AT PARIS.

ELECTRIC LIGHT.

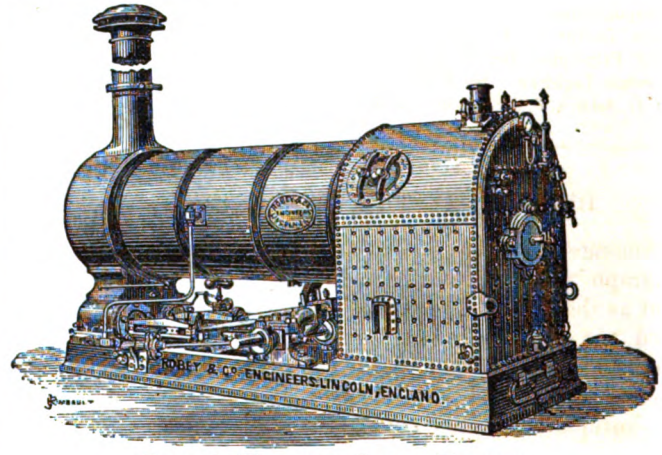
The apparatus is still far from completely arranged, hardly any of the electric light machines being ready for use; but still, much has been done during the past week and in all probability another 10 days will enable the, exhibitors to finish. When the whole electric light apparatus is at work, one of the most perfect exhibitions of the various lamps and dynamo and magneto-electric machines will be seen. Hundreds of incandescent lamps and scores of arc lamps will illumine the great hall and galleries; but unless careful experiments are made by an unbiassed jury as to the coal burnt, the horse-power developed, and the light given forth, the scientific world will be but little better informed through the results of the enterprise shown by the various competitive companies. It is impossible for the general or any public to determine the economy of a system except by means of carefully-conducted experiments in which the full details of the whole apparatus are known and considered.

Electric Light Machinery.

Messrs. ROBEY and Co. have a number of engines in the exhibition of the type they term the "Patent Robey Electric Light Fixed Engine." The exhibit consists of

One	engine of	40	h.-p.	nominal
One	,,	25	,,	,,
Two	engines of	20	,,	,,
One	engine of	16	,,	,,
One	,,	14	,,	,, and
Two	engines of	12	,,	,,

It will be sufficient to describe any one of these, since they are all similar in design to the one illustrated. The boiler attached to these engines is of the locomotive type, and is connected by being bolted to the cylinder only, and carried by rollers working in grooves at the firebox end, thus relieving the boiler of all strain.



ROBEY'S ELECTRIC LIGHT ENGINE.

The base plate is formed at one end into an ashpit, with damper doors, and is made suitable for receiving the firebox end of the boiler, the other end of which is carried by a crutch-shaped casting fixed over the cylinders. The end of the base plate under the cylinders is formed into a feed water heater tank, into which the cylinder cock discharges all condensed water, and into which a portion of the exhaust is so directed as to heat the feed water to nearly boiling point before it goes into the boiler. The whole of the parts of both engine and boiler being included on one foundation, or base-plate, heavy and expensive foundations are dispensed with, the weight of the boiler and its contained water acting as an extra weight to assist in keeping the whole machinery in rigid position.

In order to obtain the delicate compensation, as explained in a preceding article, all these engines are fitted with Robey's patent equilibrium governors, which are found by experience to work well in connection with electric light apparatus.

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Electric Lamps.

Without entering at present into the details of Mr. Swan's exhibition of lamps we shall notice the development of this lamp, which has taken place in order to provide light without danger for mining operations. In the discussion which followed the exhibition of Swan's lamp at the Society of Telegraph Engineers in October last Professor Tyndall remarked that probably this form of lamp could be adapted for use in mines as a safety lamp.

Acting on this suggestion Mr. Swan designed for this purpose the lantern and lamp which is represented in the accompanying illustrations.

FIG. 1.

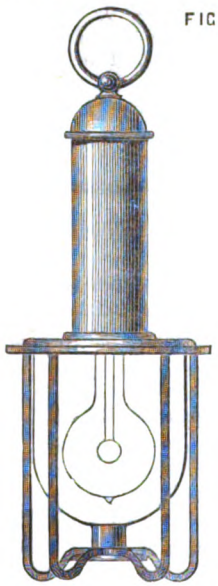
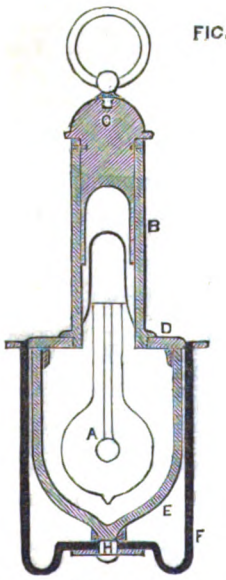


FIG. 2



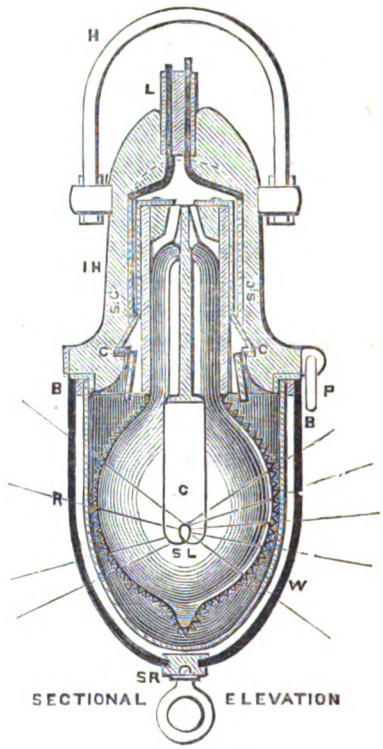
SWAN'S MINER'S LAMP.

A, Swan's Electric Lamp. B, Brass Tube. C, Wooden Cap, secured to brass tube by screws. D, Brass Collar, supporting glass cup. E, thick protecting Glass Cup. F, Guard Wires. G, Brass Cap, which supports glass and wires. H, Adjusting Screw.

This lamp, which constitutes the firstborn of a family likely in the end to prove numerous, was shown to the members of the Royal Commission about four months ago; and, in accordance with a wish then expressed, a number of lamps, made by Mr. Crompton according to a modified design of his own, were placed by Mr. Swan at the disposal of the Commission, and were employed in the experiments at Pleasley Colliery. *Vide The Electrician*, vol. vii., p. 49. Since then Swan's lamp has been practically applied to colliery work at the Earnock Colliery, Glasgow. The actual lantern employed in this application is a modification of the Swan lamp, designed by Mr. A. Jamieson, of Glasgow, and is shown by Mr. Swan.

The accompanying sectional elevation and plan (Fig. 3) are half full size, and show the latest improvements. It was in May last that Mr. Jamieson's first lantern was begun by Messrs. D. and G. Graham, of Glasgow, with a view to its being used at Earnock Colliery. But in the meantime the Pleasley Colliery experiments were made, of which we gave a full description. There Mr. Crompton showed a very good and strong design of lantern. Some objections were, however, raised as to the disadvantages under which the two workmen at the face of the coal seam were placed, by being conjointly dependent upon *one* lamp. Mr. Jamieson took the hint and had a very light but strong and much smaller lantern made by Messrs. D. and G. Graham to his designs, which he showed last month to a meeting of the Royal Commissioners on Accidents in Mines, at Victoria-street, Westminster. The gentlemen present, Warrington Smythe, Professor Abel, &c., expressed themselves pleased with it.

FIG. 3.



JAMIESON'S IMPROVED SWAN LAMP.

The main objects of protecting lanterns for incandescent lamps used at the working faces in coal mines are, to minimise the chances of the incandescent lamps getting broken by a fall or unduly severe contact with a piece of coal, by a pick or a shovel, and to prevent the possibility of a spark occurring between the leading wires and the carbon filament, as well as to form a handier means of carrying it, and to protect the hand from coming into contact with the warm glass of the incandescent lamp.

The above objects are claimed as carried out successfully in Mr. Jamieson's lantern, and we shall watch with interest its introduction into coal mines, as one of those improvements capable of being still further improved, and leading up to a state of matters when we shall hear of no more accidents in

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coal mines from the explosive gas coming into direct contact with the open flame of a miner's lamp.

The details are as follow:—(S L) Swan's lamp covered up to the neck with wire gauze. C is the carbon filament, which becomes white hot on a current of sufficient quantity being passed through it. G G is the strong glass cover, bound with a substantial brass ring, B B, to which are firmly fixed six strong wire guards, W W, with a circular wire ring, R R, connecting the six. There is a swivel ring bolt at the bottom for holding or carrying the lantern by, or even hanging it up if required. I H is the insulating handle, made of wood or ebonite, for containing the stalk of the incandescent lamp, and having side contact pieces S C, SC, firmly fixed inside and soldered to the conductors of the leading wires L L.

This insulating handle, or stalk-holder, is also bound with brass on its outside, and clamps or is fixed to the brass ring of the glass shade G G, by, first, a forward and then a left or right-hand movement, when both are firmly fixed together by means of a small padlock, P, or bolt if preferred. H H is the main handle by which the lamp is carried about or hung up; but the whole thing is so small that when being taken down the pit it may be transported with 20 or 30 feet of the flexible leading wire attached, and stowed in a big pocket for attachment to the main leading wires of the junction pieces.

In order to prevent making a spark when joining up a lamp Mr. Jamieson has devised several forms of contact pieces or circuit closers. Three of these we show in section in Figs. 4, 5, 6.

Fig. 4.

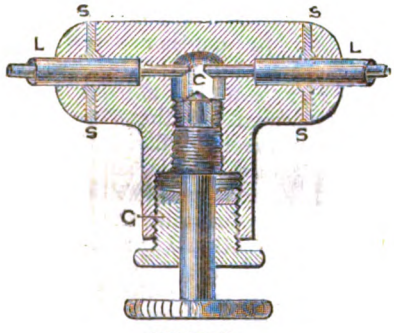
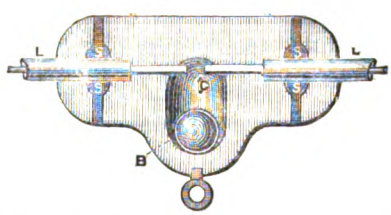


Fig. 4 represents a plan for making contact by screwing forward a brass conical contact piece tipped with platinum until it bears firmly on the tapered ends of the copper conductors of the leading wires L L. The shank next the screw is turned down and made parallel between it and the milled button, where it passes through an air tight gland, G G. The whole apparatus may be very conveniently made of wood or ebonite, with the exception of the conical brass contact at the point of the screw. Provision is made at S S for running in marine glue or shellac to render the orifice where the leads are introduced air tight, and thus prevent explosive gases from collecting in the small space at C, where the ends of the leading wire conductors come close together.

Fig. 5.

GRAVITY CONTACT

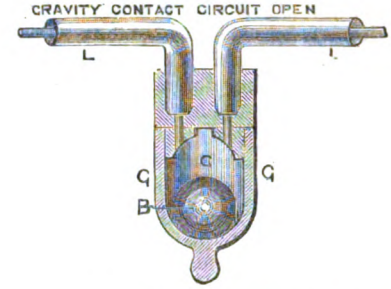


Figs. 5 and 6 are two forms of gravity contacts, where a metal ball, B, or shot or mercury leaves the ends of the conducting wires free, as in Fig. 5, but connects them or closes the circuit when in the position, Fig. 6.

In Fig. 6, G G is a glass tube with soft padding, B a metal ball resting on some metal end pieces, to which are soldered the copper ends of the conducting wires. An ebonite plug is made to fit the glass tube in a thoroughly air tight manner. There is a hook or handle whereby the whole contact or circuit closer may be hung on a nail or lifted off therefrom when contact is desired to be made or broken. Messrs. D. and G. Graham have adopted and made a modification of this plan, whereby the mercury or ball

Fig. 6.

GRAVITY CONTACT CIRCUIT OPEN



brings into circuit a resistance equivalent to that of the Swan lamp when the contact piece is in the lowered position, and they have fitted the whole of the lamps in Earnock Colliery with these double contact air tight gravity circuit closers.

Miscellaneous Exhibits.

The Postmaster-General exhibits a collection of historical and other apparatus, which has been admirably arranged by Mr. H. R. Kempe. Among the historical instruments are shown the first five-needle instrument constructed by Wheatstone, in 1837, and interesting specimens of the development of the needle instrument from the complicated five-needle to the simplified one-needle instrument, largely used even now in local circuits, and on railways. From complication to simplicity has become almost an axiom in applied science, as it is truly axiomatic in mathematics. We noticed, also, a number of coils, showing similar development, from those constructed in the olden days of electricity to the modern forms as designed by Varley and Spagnoletti. Perhaps one of the most interesting features of this exhibit is a portion of the Ronalds underground telegraph, as it was tried at Hammersmith as long ago as 1816. Another exhibit is the first A. B. C. instrument of Wheatstone, constructed by him in 1840. This is the well-known magnetic apparatus, and may be compared with Henley's magnetic instrument, as constructed in 1848, and pretty generally used by the old Magnetic Telegraph Company. From 1816 to 1850 is a leap, but these dates are those when Ronalds tried the first underground cable, and when France and England were first connected with a cable. A specimen of this latter cable is shown, and the visitor may easily compare the first submarine cable with those of recent construction as manufactured by the various companies and shown by the department. We also noticed a piece of apparatus which ought to-day to attract more than ordinary attention. We refer to Varley's secondary battery, which was long used at the Central Office for the transmission and distribution of time-signals from Greenwich. A number of keys and relays are shown, as is also a Bain double needle instrument.

The India Rubber, Gutta Percha, &c., Company, of Silvertown, among other exhibits, show a specimen of Brooks's Patent Underground Telegraph. The distinctive feature of the system of underground telegraph lines patented by Mr. David Brooks, of Philadelphia, United States, is the use of petroleum oil as the insulating material. Each conductor is covered with jute to prevent contact, and the required number of conductors being cabled together in lengths of 1,000 to 2,000 feet are drawn into an iron pipe, which is then filled with oil. To supply any slight loss of oil by leakage, and to allow for variations of temperature, a small reservoir open to the air is constructed at the highest point of the line, and connected with it by a vertical pipe. Joint-boxes are inserted in the pipe at intervals of from 1,000 to 2,000 feet, and in these boxes the ends of the wires are joined, the cavity being filled with oil and made tight with a screw plug. The joints of the pipes are made tight

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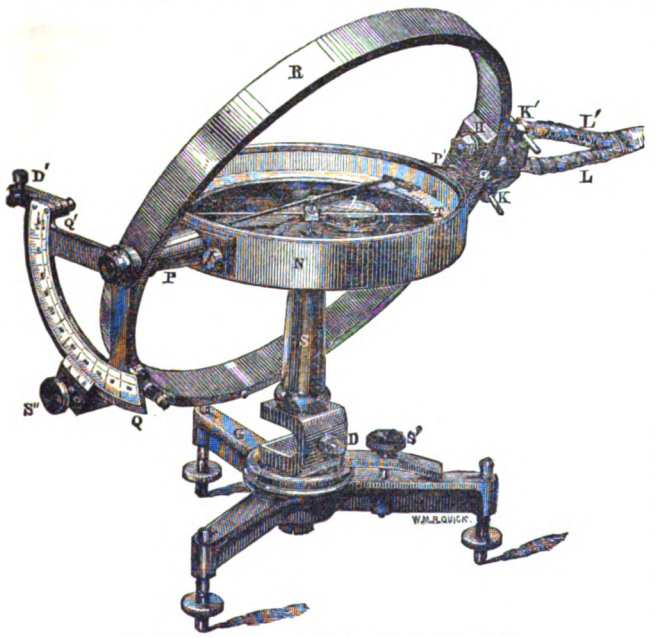
with conical screws, the threads of which are filled with shellac. Where the conductors are brought out of the pipes to be attached to instruments a few feet of india rubber-covered wire are spliced to each, and led through a terminal box tightly filled with solid paraffin, which covers the joints and effectually prevents any escape of oil. The chief advantages claimed for the Brooks system are:—1. Freedom from inductive interference between contiguous wires, and from the retardation experienced when gutta percha is used as an insulator. Brooks's cable is therefore stated to be specially useful where automatic or fast-speed instruments are used, and where the wires in a cable are partly on telegraphic and partly on telephonic circuits. An astatic galvanometer placed on one of the circuits while the others are in use shows no deflection. 2. The unvarying condition of the cable. Steady, constant, uniform work is always obtainable from it, petroleum oil being one of the most stable of substances, and having no deteriorating effect on copper, jute, or iron. 3. Immunity from the effects of changes of temperature, atmospheric disturbance, moisture, frost, snowstorms, or gales. There is no danger of interruption from contacts, breaks, or any of the accidents to which overhead wires are liable; no need of frequent readjustment of instruments and batteries; no danger to life from the fall of poles and entangled wires. 4. The cost of maintenance is trifling. 5. For telephonic purposes as many as 300 conductors can be placed in a pipe with an internal diameter of an inch and a quarter, and that without any disturbing effect arising from induction.

Messrs. Siemens' fine exhibit includes, among other apparatus, Obach's Patent Tangent Galvanometer, with movable ring. This galvanometer is designed principally for the accurate measurement of the very powerful currents given by dynamo and magneto-electric machines as used for the electric light, for plating and depositing purposes, &c. The ring through which the current passes is movable around its horizontal diameter lying in the meridian; the inclination of the ring to the horizontal plane is read off on a vertical scale. With a constant current strength, the force with which the magnetic needle in the centre of the ring is deflected from



Obach's Tangent Galvanometer.

the meridian is proportional to the *sine* of the angle which the plane of the ring encloses with the horizontal plane. Instead of measuring the angle between the ring and the horizontal plane, the angle which the ring makes with the vertical plane could also be taken, but in this case the *cosine* of the observed angle would be employed in place of the sine. In this instrument the angle of the ring with the horizontal plane is read off, as the natural values of the sine are more frequently given in tables than those of the cosine, and can be used without further trouble. Above is a perspective view of the apparatus, showing the ring in an inclined position. From a base, G, provided with three levelling screws, rises a stout brass column, S; the bottom of this column is formed of a square block cut out at one side in the shape of a ⊃, and made strong enough to insure it against bending. The column can be turned on its axis in order to place the instrument in the magnetic meridian; the screw S′ holds it firmly in its place. On the top of the column is a circular brass box, N, about 8in. in diameter and $1\frac{3}{8}$in. high. Conical arms, P P′, are screwed to opposite sides of the box and serve to support the ring R. This ring is made of gun-metal containing a high percentage of copper; the dimensions are $11\frac{3}{4}$in. inner diameter, about $\frac{3}{8}$in. thick and 1in. broad, so that the ring offers an exceedingly small resistance to the current. At *a* the ring is cut through; on the outer face and at each side of the opening a semi-circular piece of gun metal with clamp screws, K′ K, is fixed. On the inner face of the ring the opening is bridged over by a strong piece of ebonite, H, in which a brass bush is inserted to hold the pivot on the end of the arm P′. The pivot on the arm P projects somewhat beyond the ring R, and is insulated therefrom by an ebonite collar, over which is placed a brass collar for the ring to turn on. On this projecting pivot the quadrant Q′ Q is placed, and held firmly by a pin. This quadrant is divided into degrees, and the angles, the sines of which (for radius = 1) correspond to the values 0·1, 0·2, 0·3 . . . 1·0, are shown on the same scale by longer marks. Fixed to the ring R and insulated therefrom is a brass arm carrying at its end a vernier, which moves over the quadrant Q. The screw S″ clamps both vernier and ring; the latter at its extreme vertical position is arrested by a screw D shown in the lower part of the column and by another screw D′ (see Figure) when in the horizontal position. On loosening the screws *q* and *p* the vernier can be shifted a little, so that when the zero adjustment of the ring is first made the required agreement between the divisions on the vernier and quadrant can be obtained. This adjustment is made by sending as strong a current possible in alternate directions through the ring and then bringing the latter by alteration of the screw D′ into such a position that no deflection of the needle takes place. When this is the case the vernier is set to zero. Within the circular box N, and at about half its height, is the circle T, divided into degrees of sufficient size to enable a tenth to be easily estimated. The length of the magnet is only 1-15th the diameter of the ring; it carries an aluminium pointer, and is fixed to an axis, which is worked to a fine point at each end. On the circle T, in an exact line through the bearings of the ring, is screwed a light brass frame having an agate bearing in the centre, and beneath it in the middle of the box is a second jewel or agate bearing. In these bearings the axis of the magnet plays. A screw underneath the brass box, acting on a brass spring, stops the movement of the needle. A small spirit level, *l*, is fixed in the box, so that the galvanometer may be accurately levelled. The current to be measured is led to the ring by means of two thick insulated copper wires, L L′, which are wound together for a distance of about 3 feet, and connected to the clamp screws K K′. If greater accuracy is required it is advisable to take readings on both sides of the zero position, viz., to change the direction of the current in the instrument by means of a suitable commutator.

The following three cases illustrate the various methods of measuring currents with this galvanometer:—

1. Currents of *different* strength, $I_1, I_2, I_3, \ldots$, sent through the ring at the *same* inclination ϕ, showing deflections a_1, a_2, a_3, give—

$$I_1 : I_2 : I_3, \ldots = \text{tan. } a_1 : \text{tan. } a_2 : \text{tan. } a_3 \ldots$$

viz., the law of tangents holds also for the inclined ring.

2. The *same* current I sent through the ring at *different* angles of inclination $\phi_1, \phi_2, \phi_3 \ldots$ gives

$$\text{tan. } a_1 : \text{tan. } a_2 : a_3 \ldots = \text{sin. } \phi_1 : \text{sin. } \phi_2 \text{ sin. } \phi_3 \ldots$$

$$\text{or } \frac{\text{tan. } a_1}{\text{sin. } \phi_1} = \frac{\text{tan. } a_2}{\text{sin. } \phi_2} = \frac{\text{tan. } a_3}{\text{sin. } \phi_3} = \ldots = \text{constant.}$$

The tangents of the deflections are, therefore, in the same proportion as the sines of the inclinations; or, in other

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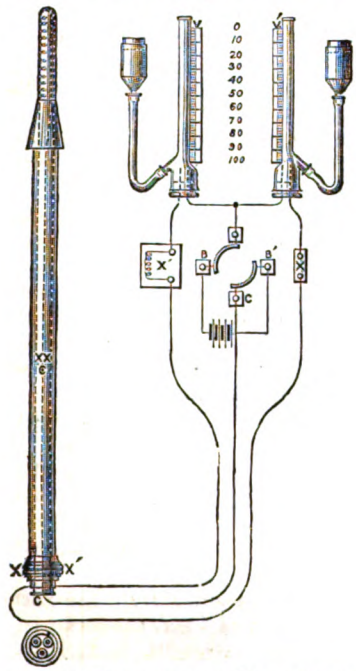
words, the tangents of the deflections divided by the sines of the corresponding inclinations give for the same strength of current a constant value.

3. For different currents $I_1 : I_2 : I_3 \ldots$ sent through the ring at inclinations $\phi_1, \phi_2, \phi_3 \ldots$ giving the same deflection a (say of 45 deg.), we have

$$I_1 : I_2 : I_3 \ldots = \frac{1}{\sin.\phi_1} : \frac{1}{\sin.\phi_2} : \frac{1}{\sin.\phi_3} \ldots .$$
$$= \text{cosec } \phi_1 : \text{cosec } \phi_2 : \text{cosec } \phi_3 \ldots$$

and the instrument thus used acts as a *cosecant* galvanometer.

Another interesting piece of apparatus shown by Messrs. Siemens is the electrical pyrometer, designed by Dr. C. W. Siemens, F.R.S. The electrical resistance of metal conductors depends upon their dimensions, material, and upon their temperature; an increase of the latter causing a corresponding increase of resistance. The law of this increase is known. Thus, the resistance of a conductor being ascertained at 0 deg. centigrade it can be calculated for any temperature, and, *vice versâ*, if the resistance can be found by measurement the temperature can be calculated. This is the principle upon which Siemens's electrical pyrometer is based. A platinum coil of a known resistance at 0 deg. centigrade is coiled on a cylinder of fire-clay, protected by a platinum shield, which is placed is an iron or platinum tube, and then exposed to the temperature to be determined. Leading wires are arranged to connect this coil with an instrument suitable for measuring its resistance, and from this resistance the temperature can be calculated. The instrument supplied for this purpose is a differential voltameter. The differential voltameter consists of two separate glass tubes, in each of which a mixture of sulphuric acid and water is decomposed by an electrical current passing between two platinum electrodes. The gas which is generated is collected in the long cylindrical and carefully calibrated top of the tube, and its quantity is read off by means of a graduated scale fixed behind the tubes. Movable reservoirs are provided communicating with the tubes to regulate the level of the liquid.



SIEMENS' ELECTRICAL PYROMETER.

The current of the battery is divided (by passing a commutator) into two circuits, one of which consists of an artificial resistance in the instrument and the platinum electrodes in one tube; the other, of the resistance to be measured and the electrodes in the other tube. The quantities of gas developed in the two tubes are in inverse proportion to the resistances of their respective circuits, therefore one of the resistances, viz., that in the instrument, being known, the other can be calculated. When used the battery glasses are filled with pure water, or, in case of the power of the battery decreasing, with a solution of sal-ammoniac in water. The poles to B and B′ are connected on the commutator, and the small end of the pyrometer-tube is exposed, as far as the cone, to the heat to be measured, and the terminals x, x', c connected to the ends of the leading cable bearing corresponding letters. The other end of the leading cable is connected to the terminals x, x', c on the voltameter. The differential voltameter has to be filled with the diluted sulphuric acid through the reservoirs, the india rubber cushions being lifted from the top of the tubes. The commutator has to be turned so that the contact springs on both sides rest on the ebonite. The liquid in both tubes has to be regulated to the same level 0 deg. of scale, and the india rubber cushions to be let down again. A quarter of a turn is given to the commutator, and the development of gas commences almost immediately. The commutator is turned half round every ten seconds to reverse the current. The current is kept passing until the liquid has fallen in the tubes to at least 50 deg. of the scale, then the commutator is put into its first position, so that the contact springs rest on the ebonite, and the level of the liquids is read off on the scale marked V, and the scale marked $\dot{V}$. These numbers are given in tables under V and $\dot{V}$, and the intersecting point of the lines starting from these figures gives the temperature in degrees centrigrade.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES AUGUST 17.		BUSINESS DONE WEEK ENDING AUGUST 17. Highest.	Lowest.
Anglo-American	51,	½	52	51½
Do. Preferred	81½,	2½	83½	81⅝
Do. Deferred	23½,	4½	25⅛	24
Brazil Submarine	10⅛,	⅞	—	—
Cuba	9½,	10	9¾	9⅝
Do. Preference	16½,	17	—	—
Direct Spanish	4⅞,	5¼	—	—
Do. Preference	14,	15	14⅝	14½
Direct United States Cable	10⅜,	⅝	10⅝	10⅝
Eastern Telegraph	10⅜,	⅝	10⅝	10⅝
Do. 6 per Cent. Preference	12½,	13½	13½	13
Do. 5 per Cent. Debentures, 1899	105,	108	—	—
Eastern Extension	11,	¼	11¼	11¼
German Union	10½,	11	10⅝	10⅝
Globe Telegraph and Trust Company.	6⅛,	⅛	6 11-16	6⅛
Do. Preference	12⅜,	⅜	12⅜	12⅜
Great Northern	13,	¼	13⅜	13⅛
Indo-European	28,	29	—	—
Mediterranean Extension	2½,	3	2 13-16	2⅝
Do. Preference	9,	⅛	9⅛	9⅛
Reuter's	12,	13	12⅛	12⅛
Submarine	280,	90	—	—
West India and Panama	1½,	2	—	—
Do. 1st Preference	7,	¼	—	—
Western Brazilian	7⅞,	8⅛	8	8
West. Union 7 per Cent. 1st Mortgage	125,	130	128½	128½
Do. 6 per Cent. Sterling Bonds	106,	110	—	—

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Tenders to be sent to the undersigned on or before the 10th SEPTEMBER next, who will furnish all necessary information.

JOSEPH W. HOWARD, Town Clerk.

Town Hall, Waterford, August 12th, 1881.

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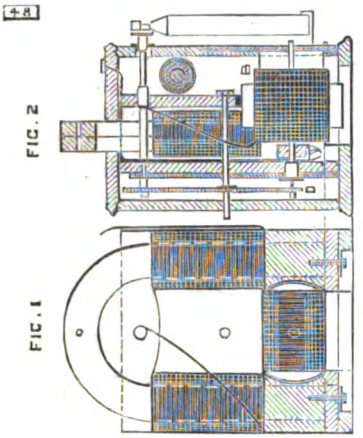
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

48. GENERATING AND UTILISING ELECTRICTY FOR LIGHTING AND OTHER PURPOSES, *W. R. Lake.—4th January*, 1881.—*(A communication from F. Etève.)* 6*d*.

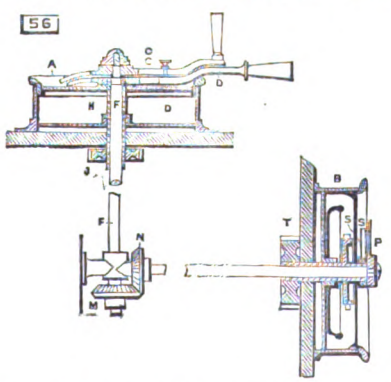
The first portion of this patent refers to a magneto-electro machine, and the latter portion to an electric lamp. Figs. 1 and 2 are illustrations of the machine, the chief feature of which is the coil B, which is actuated by a pair of toothed wheels D. It presents only two induction poles, and therefore only two points of resistance. To render this proportionately small coil effective, the inventor constructs it of a varying number



of plates according to the power to be developed, the plates being placed one above another, and so connected as to form a whole. The current developed is sent into two friction brushes by means of a small commutator. The wires are so arranged that the current returns into the coils of the magnet in the field of which the coil rotates. The current which is produced is collected in two terminals, which serve for attaching the wires of apparatus such as lamps, medical coils, &c. The figure shows an arrangement for lighting spirit lamps, &c.

56. MECHANICAL TELEGRAPHS, *W. Chadburn.—5th January*, 1881. 6*d*.

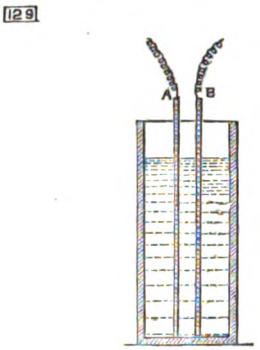
A is the transmitting and B the receiving instrument, over the dials of which pointers C and D move, such pointers being placed over each other, and moving together when the ordinary indications "ahead" and "astern" are required to be sent, but which by removing a pin can work separately so as to be placed one on the tens and the other on the units, when the number of revolutions are required to be telegraphed. The two



instruments are geared together as follows:—The unit pointer D is mounted on a hollow shaft H, through which passes shaft F carrying pointer C. The pointers S and P of instrument B are similarly arranged. Shaft F carries bevel wheel M gearing with N, on the shaft of which pointer P is keyed, while shaft H carries wheel J gearing with another spur wheel, on the shaft of which is a bevel wheel gearing with a similar wheel, on the shaft of which is a spur wheel gearing with wheel T keyed to the hollow shaft carrying pointer S.

129. GALVANIC POLARISATION BATTERIES OR MAGAZINES OF ELECTRICITY, &c., *J. H. Johnson.—11th January*, 1881.—*(A communication from C. Faure.)* 6d.

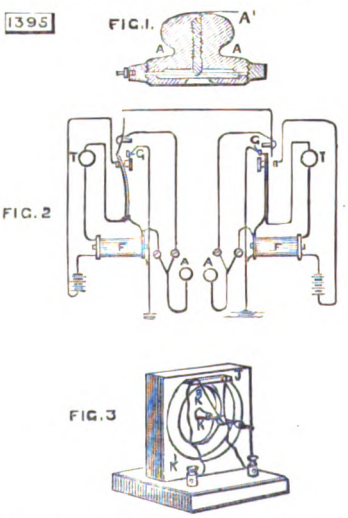
This relates to batteries which, though incapable of themselves producing electricity, will, when charged from some other source, retain and furnish when required the charge of electricity. In carrying the invention out, leaden plates are mechanically covered with a coating of metallic salts, mixed with inert substances, as, for instance, a coating of lead mixed with pulverised coke, which mixture may be moistened with a small quantity of gelatine. When two elements prepared in this way and coupled together as in a battery in dilute sulphuric acid are connected with some electrical source, it is found that the sulphate of lead will be reduced on one of the plates and form an adhesive porous coating.



After this has been done for one of the plates, the current is reversed so as to reduce the other element; but by so doing the first element becomes re-oxidised, and lead oxidised under such conditions becomes per-oxidised, so two elements are obtained covered with lead in a porous state, and the covering of one of the elements is per-oxidised. This pair of elements thus becomes a magazine of electro-chemical energy, and is capable of acting as a galvanic battery. Various other methods of effecting the same object may be employed. The figure is an illustration of a pair of elements of two thin lead plates, A and B, covered with a porous covering and placed in a rectangular vessel containing dilute sulphuric acid. Other illustrations of different methods of preparing the elements are given. These batteries may be used to work various kinds of machines, to drive boats, &c.

1395. ELECTRICAL APPARATUS FOR THE TRANSMISSION OF SOUND, *W. R. Lake.—29th March*, 1881.—*(A communication from A. E. Dolbear.)* 6*d*.

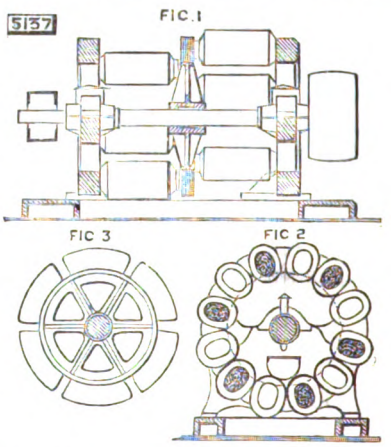
Professor Dolbear claims improved telephonic receivers and transmitters. Fig. 1 is a central section of the receiver. The case of receiver is in three pieces, a back piece, an ear piece, and a



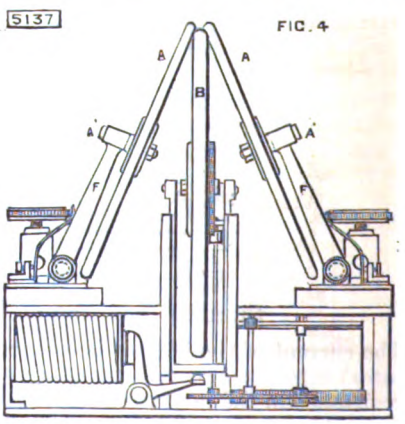
connecting piece; their elastic plates, preferably of iron, forming terminals of the secondary coil of an induction coil. These places are very near each other, only separated by a thin ring, and a screw serves to adjust. It is not necessary to use both terminals of the secondary, and several modifications are described. The advantages claimed are that ordinary induced currents do not appreciably affect the work; it has no magnet to deteriorate, the adjustment is simple, is not affected by barometric and hygrometric variations, is efficient on very long lines, &c. Fig. 2 shows the arrangement of the apparatus for work; A A are the receivers, F the induction coils, G the switches, T the transmitter. The transmitter T and battery are in circuit with the primary coil of F, and this circuit is completed when the transmitter is to be used by means of the switch, and the transmitter consists of a diagram, K, Fig. 3 (similar to the usual telephone diaphragms) mounted vertically in a suitable standard, K^1. The terminal K^3 is supported by the hanger J, so that it may bear against the terminal K^2. Both the electrodes K^2 and K^3 may be of carbon, and J may be electrically connected with its support by mercury cups, as shown. If one of the instruments is arranged in the primary circuit of an induction coil and another in the secondary circuit, sounds spoken at the diaphragm of the first will be reproduced by the second instrument.

5137. ELECTRIC MACHINERY AND APPARATUS FOR THE PRODUCTION OF LIGHT AND HEAT, *G. W. T. Henley.—9th December*, 1880. 2*s*. 8*d*.

This patent includes several distinct items—first, a dynamo machine partially shown by Figs. 1, 2, 3, its peculiarity being more especially in the armature wheel, which is fitted with a number of



soft iron pieces on its circumference, and revolves between two sets of electro magnets, the poles of which are not opposite but intermediate to each other, or there may be a combination of such wheels or various modifications. Another peculiarity is the combination of an exterior circular series of magnets held in stationary ring frames, and an interior double star shaped armature revolving in close proximity to the poles of these magnets. The inventor also claims the system of winding, of



certain applications of electro-magnets, a commutator of rods each having a short and a long leg dipping into mercury cups, &c. Secondly, an arc lamp, one modification of which is shown in Fig. 4. A A are carbon (or other suitable material) discs, mounted on spindles A^1, fitted in jointed lever F. The spindles incline to one another. The material B is of such a kind as to burn or melt away equally with the carbons.

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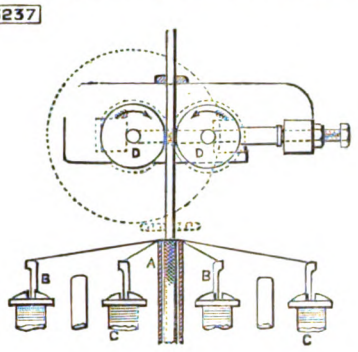
5237. Braiding, Lapping, or Covering Telegraph Wires, Crinoline Steel, Engine Packing, &c., *W. T. Glover and G. F. James.*—*14th December*, 1880. 6*d*.

The wire or other core to be covered is forced through the tube A by means of a pair of squeezing rollers D geared together and caused to re-

5237



volve at the desired speed, the distance between them being adjustable so as to suit different thickness. B are the tops of the braiding spindles carrying the bobbins C.

5268. Apparatus for Transmitting Drawings, Characters, and Writing by Electricity, &c., *A. W. L. Reddie.*—*15th December*, 1880.—(*A communication from J. André*). 6*d*.

This invention consists in the use of a band of composite tissue or web of convenient length formed by the grouping of a variable number of metallic conducting wires, which are insulated from one another by means of a weft of textile material, the warp threads being formed by the conducting wires themselves, as shown in Fig. 1.

5268 FIG. 1.

In applying this conducting web to telegrapic purposes over long distances, the gauge of the wires should be large. At each intermediate station on the line the ends of the conductors are bound together with rubbing surfaces or brushes of a similar web, but formed of finer wires, each of which corresponds to one of the wires of the main conducting web. The ends of the wires of the main web are not fastened directly to the wires of the brushes of transmission, but are connected by a commutator. Fig. 2 shows a sectional side elevation of the apparatus used in reproducing a tracing. The reproduction is effected as follows :—The tracing is made to pass under one end of a

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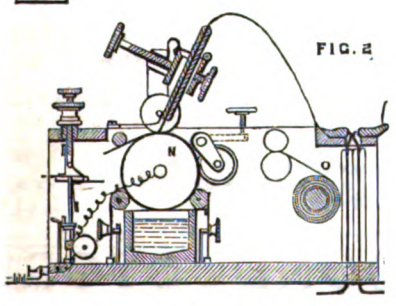


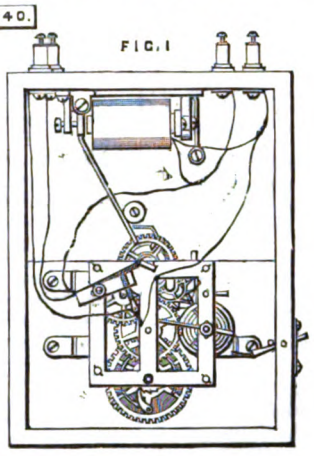
brush at the transmitting station at the same time that a receiving surface, formed of a continuous band of paper, O, is caused to pass under the corresponding brush at the receiving station. This paper O is chemically prepared, so as to be changed by the electric current, which reproduces the original design. O passes over a metal cylinder, N, rotated by clockwork and governed by a fan. One of the poles of the battery is in communication with earth, whilst the other is connected with receiving cylinder, N, communication with line being established by means of the brushes.

5340. Improvements in Telephone Signal Apparatus, *W. Morgan-Brown.*—*20th December*, 1880.—(*A communication from G. H. Bliss.*). 8*d*.

This invention relates to telephone signal apparatus, which contains a series of clockworks arranged to run synchronously, and each controlling a signal bell in the circuit, so as to allow it to sound only at certain pre-determined periods of time, the said periods being different at each instrument, so that only one signal can be operated at any one time, the others being kept silent by the controlling clockwork. Fig. 1 is a front view of the apparatus with the clockwork stopped; Fig. 2 gives details of the main-shaft and mechanism, also the dial; Fig. 3 shows the arrangements of circuits. The operation is as follows :—The instruments are normally all stopped, the levers G engaging one of the stop

5340.

FIG. 1



shoulders 5 of the stop cams H and the toes P holding the springs N disconnected from the pins M. The cams V are then at different distances from the ends of the springs U, and the pointers W are at zero and vertical. Supposing it is desired to signal station 4, the operator sends a current which passes all the starting magnets, and causes them to attract their armatures, and by connected fingers to throw the levers G off from the shoulders 5 of the cams H, allowing all the clockworks to start simultaneously. As the pointer W passes through the space 1 the signalling shunt 21, 22, 23, 24 at the first station is broken by the cam V engaging the spring U, and as the said pointer passes to space 2 the signalling shunt at station 1 is closed, and at station 2 is broken, and a similar operation takes place as

5340.

FIG. 2

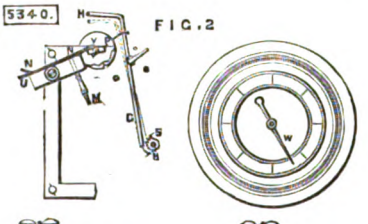
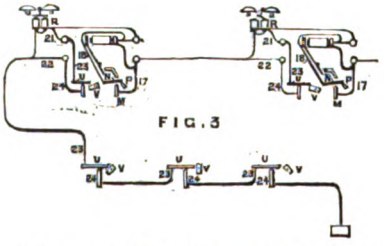


FIG. 3

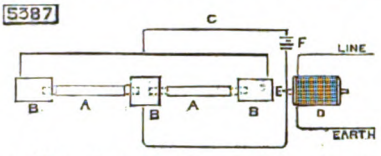


the pointer passes into the spaces 3 and 4, while the pointer is passing through space 4, and the signal shunt at station 4 is consequently broken, the operator sends currents to line to operate signals, and the said currents in passing over the line will follow the shunts 17, M, N, 18 around the starting magnet, the said shunts being closed when the clockworks first started, and at all the stations except station 4; the said currents will also pass through shunts 21, 23, U, I, 24, 22, about the signalling magnets R, which will consequently not be operated thereby, but at station 4 the currents will be obliged to pass through the coils of and operate the signalling magnet R, since the signalling shunt is broken at this point by the cams V. The operator may continue to send the currents and operate the signal at station 4 as long as the pointer W is passing over the space 4, and the cam V at station 4 is holding up the spring 22, but the moment that it arrives at the end of the said space the said currents must close, as after this moment they would operate the signal at station 5 instead of that at station 4.

5387. Improvements in Micro-transmitters, *W. Johnson.*—*22nd December*, 1880. 6*d*.

This invention is a new arrangement of Professor Hughes' microphone. In carrying it out the inventor arranges a microphone consisting of two carbon pencils, supported on a diaphragm, and between the ends of these pencils he connects bobbins of insulated wire so as to cause them to resist the passage of an electrical impulse. The apparatus is then coupled up as shown in the figure, the electrical connections being as follows :—The positive current from F passes through the primary E of induction coil D to central block B; it then divides between the arms, or takes the arm or pencil which offers the least resistance,

5387



being either A or A^1, and completes the circuit through a connection. If contact is momentarily interrupted in the arm A, A^1 allows the circuit to be completed, and *vice versâ*, thus a breakage in the primary circuit is obviated; in order, however, to render the manifestation in the receiving telephone of such a breakage impossible, a branch circuit, C, is introduced, so that if a breakage occur in the circuit through the microphone, the circuit can be made through C. This arrangement is claimed to obviate induced currents and to procure clear articulation. (A more detailed description will be found in *The Electrician*, Vol. VII., No. 10.)

5482. Telephonic Apparatus, *C. J. Wollaston.* *30th December*, 1880. 6*d*.

This invention has for its object the construction of a portable telephonic apparatus suitable for use in military and naval operations, mine explorations, &c. The apparatus is composed of a box with hinged cover at top, this box is divided into compartments, in one of which is the battery, in another is the receiving telephone with accessories, in another is the signal bell. In the upper portion of the box is located a transmitter, by the side of which is pivoted the switch for throwing the bell, transmitter, and receiving telephone in and out of circuit. The switch is so arranged that by the action of closing the lid of the box the

5482

FIG. 1.

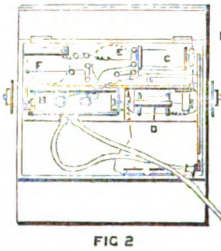
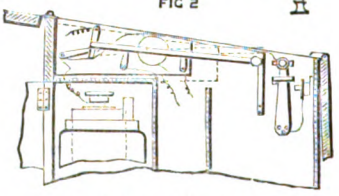


FIG 2



battery is cut out of circuit. The box also contains bell key, button, terminals, binding posts, &c. The apparatus when used in connection with diving apparatus or for other purposes of same nature, is provided with extra terminals for an additional wire, and a switch is so arranged as to bring the home battery or an additional battery at the home station into connection with the distant transmitter, which is placed in the helmet of the diver. For example, Fig. 1 shows the arrangement of the apparatus in the box; Fig. 2 shows the arrangement of the switch; B is the telephone receiver, D electric bell, in the compartment marked E is the microphone transmitter consisting of an arrangement of multiple carbons, G is the induction coil, F the battery.

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ADDRESSES.

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TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

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Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
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RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

VULCANITE.

HARBURG INDIA-RUBBER COMB COMPANY.
LONDON WAREHOUSE: F. WINTER.
138, LONDON WALL, WOOD ST., E.C.

EBONITE.

DUNCAN WALLET & CO.,

BONDED STORE AND PROVISION MERCHANTS,

15, BILLITER STREET, LONDON.

Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

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(PATENT).

LOUD AND CLEAR. NO JARRING.
PERMANENT ADJUSTMENT.
NO OXIDATION. ONE LOCAL CELL.

TASKER, SONS & CO.,

ELECTRIC AND TELEPHONIC ENGINEERS,
SHEFFIELD.

ELECTRIC LIGHT.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

ELECTRIC LIGHT.

THE ELECTRIC LIGHT and POWER GENERATOR COMPANY (Limited) are prepared to take orders for either the

INCANDESCENT LIGHT,

30 to 60 candle power (burning in vacuo), for domestic purposes, or the

ARC LIGHT

for Halls, Railway Stations, Streets, &c., &c.

Particulars, Price Lists, &c., by application to
The SECRETARY, 29, BANKSIDE, SOUTHWARK.

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

Southampton-buildings, Chancery-lane

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Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

SOLE PATENTEES OF UNTWISTED WIRE ROPE.

Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c.

Gilt and Silver Cord for Hanging Pictures. Iron, Steel, and Copper Cord for Clock and Sash Lines, &c.

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SLIP

South America.—The cables between Bahia and Rio de Janeiro and between Rio Grande du Sul and Monte Video are repaired.

Brazilian Submarine Telegraph Company.—The traffic receipts of this Company for the week ended 19th inst. amounted to £2,806.

Postal Appointments.—Mr. J. Muir, a telegraph instructor in the North-Eastern District, has been appointed as a post office surveyor's clerk.

Electric Light in Edinburgh.—We hear that Messrs. R. E. Crompton and Co. are lighting Holyrood Palace, Edinburgh, with their lights.

Scilly Islands.—Communication with the Scilly Islands is interrupted. The Post Office announce that telegrams will be forwarded by post from Penzance.

A Royal Visitor to the Exhibition.—H.R.H. Princess Louise, Marchioness of Lorne, visited the International Electrical Exhibition towards the latter end of last week.

A New Work on Telephones.—M. E. Bède, who was one of the first to introduce the telephone into Belgium, has just published a book entitled "Histoire des Téléphones."

Electric Light in Govan, near Glasgow.—Messrs. D. and G. Graham, of Glasgow, have contracted to light the tube works of Mr. John Wilson, in Helen-street, Govan, by the electric light.

The Electric and Magnetic Company.—The creditors of this company must send particulars of their claims by the 30th September to Mr. Dalton Easum, the official liquidator, at 302, Regent-street, W.

Telegraphic Communication with Iceland.—It is stated that a company is being formed to lay a cable, by way of the Faroe Islands, to Iceland. The statement emanates from Copenhagen.

Observance of Sunday at the Exhibition.—We have received a circular from the Lord's Day Observance Society, requesting exhibitors to abstain from exhibiting on the Sunday during the exhibition.

Electric Light at Belfast.—Last week the four lamps erected by Messrs. R. E. Crompton and Co. to light Donegall Quay in Belfast Harbour were lighted for the first time. The lights are said to have given great satisfaction.

Delegates to the Congress at Paris.—We understand that Professor W. F. Barrett and Mr. G. FitzGerald, F.T.C.D., have been appointed delegates from the Royal Irish Academy to the Electrical Congress at Paris.

The Telephone at Canterbury.—Telephonic communication is to be established between the Gasworks in Castle-street, and the Water Works in Wincheap, Canterbury. The wire will be 1,200 yards long, and carried underground in iron tubes.

The Telephone in Italy.—The Telephonic Exchange in Rome has more than one hundred subscribers. The Société Générale Italienne des Téléphones have established exchanges in other large towns. The instrument used is the Crosley and Nigra.

The New Atlantic Cable.—On Monday evening last the telegraph steamer "Faraday" picked up the shore end of the new Atlantic cable, and, having made the necessary splice, proceeded on her outward voyage, laying the mid-ocean section.

Western and Brazilian Telegraph Company.—The traffic receipts of this Company for the week ending August 19th amounted to £1,853, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company.

The Telephone in Belgium.—The *Chronique des Travaux Publics, &c.*, says that the telephone is being made use of at Bromberg by the Canal Inspection Department. The wires and apparatus have been installed at an estimated cost of 125 francs (or £5) per kilometre.

West India and Panama Telegraph Company.—The estimated traffic receipts of this company for the half month ended Aug. 15 were £1,669, as compared with £1,312 in the corresponding period of 1880. The May receipts, estimated at £5,560, realised £5,525.

Electric Light for Vienna.—It is stated that an electric light company has offered to light one of the squares of Vienna at its own expense as an experiment, and that the Municipality have accepted this offer for the street called La Graben, and the Place de la Cathédrale de St. Etienne.

Spiders and the Telegraph.—In Japan the spiders spin long webs from the telegraph wires to the trees and to the earth, which, in wet weather, become good conductors and carry off the current. Men are, therefore, employed to keep the lines clear, which they do by brushing them with long bamboo poles.

Repairing the Shetland Cable.—The telegraph steamer "Dacia" has arrived in Shetland, and taken in hand the work of repairing the cable, which has been broken now for about six months. After making the necessary examination at the shore end of the line, the steamer proceeded to sea to lift and repair the cable.

Electric Light for Trains.—A novel departure has been initiated by the Great Northern Railway, on which they are to be congratulated. Messrs. R. E. Crompton and Co. have contracted with the company to fit up a train with the Swan incandescent lamps. The result of this experiment will be looked forward to with great interest.

Prices.—The prices as quoted this week are, for gutta percha per lb.:—Genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber, per lb.: Fine Para, 3s. 5d. to 3s. 5½d.; negrohead, 2s. 1d.; central American, 1s. 7d. to 2s. 3d.; Assam and Pegu, 9d. to 1s. 10d.; other East Indian, 1s. to 1s 10d.; Madagascar and Mozambique, 1s. 4d. to 2s. 2d.

The Monopoly.—A telegram from New York, dated Thursday night, the 18th of August, says:—"The shareholders of the Montreal Telegraph Company, at a meeting yesterday, approved the agreement with the great North-Western Company. This gives to the Western Union Company the control of the entire telegraphic system of British North America."

Results of Tenders.—The following tenders were received at the Station de Bruxelles-Nord, Brussels, on the 3rd of August, for the supply of seven Hughes printing instruments. The official estimate amounted to 10,700 francs. The tenders were from Richez and Co., 10,500 francs; Bouckaest, 10,874½ francs.; Compagnie des Téléphones, 11,900 francs; only one of which, as will be seen, was under the estimate.

A New Company.—It is reported that a new concern, to be called the Anglo-Colonial Electric Light Company, has been floated, with a capital of £8,000. It is stated to have been formed to acquire the patent rights for England, India, and any other British possessions granted to Leonard Jules Bouteilloux, M.D., and W. Laing, both of Paris, for improve-

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ments in means or apparatus for producing the electric light.

NEW CABLE BETWEEN TRIESTE AND CORFU.—We hear that Messrs. Erlanger, of Paris, have just obtained the necessary authority for laying the submarine cable between Trieste, in Austria, and the island of Corfu, as well as the proprietary right of the said cable for a period of twenty years. The new cable will facilitate telegraphic communication between Austria and Egypt. The cost is stated to be estimated at one million florins.

A PECULIAR TASTE.—The Carmarthen County Justices have just committed an Irishman named Hurley to one month's hard labour for snatching up from a table in an inn, chewing, and swallowing a telegraphic message, with a shilling wrapped up in it, that was intended for transmission elsewhere than down his, apparently, capacious maw. One month's hard labour will no doubt do much towards aiding digestion of the toothsome morsel.

TELEGRAPHIC COMMUNICATION WITH LIGHTSHIPS.—A deputation from Ramsgate, consisting of Mr. Hobbs, the Rev. Mr. Gilmour, and other gentlemen, waited upon Sir Thomas Brassey, at the Admiralty, the other day, and presented a petition bearing 10,000 signatures in favour of telegraphic communication being established between lighthouses and the shore, to be used in case of storms. Sir Thomas Brassey promised attention to the representations made to him.

INTERNATIONAL ELECTRICAL EXHIBITION.—THE JURORS.—It has been decided that though there are 1,200 French exhibits and but 500 in all the foreign sections, the international jury shall consist of French and foreign members in equal numbers. The foreign sections are requested to propose jurymen in proportion to their exhibits. The minimum number of the jury is fixed at 100. The committee will place at the disposition of the jury fifty gold medals, 200 silver, and 500 bronze.

LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY.—This Company give notice that the half-yearly coupons which fall due on the 1st September next, of £100,000 Seven per Cent. Debentures of the River Plate and Brazil Telegraph Company, will be paid by Messrs. Glyn, Mills, Currie, and Co., bankers, at 67, Lombard-street, E.C., on and after the 1st September. The coupons must be left with Messrs. Glyn, Mills, Currie, and Co., for examination, three clear days before they can be paid.

THE POSTAL AND TELEGRAPH SERVICES.—Mr. G. Stewart Macliver, M.P., has given notice of the following Motion:—"To move, early next Session, for a Select Committee to enquire into the working and management of the Postal and Telegraph Services, with a view to ascertain whether increased facilities and lower rates cannot be afforded; and also to consider and report on the relationship of the letter-carrying and telegraph services to each other, and the best means of securing efficiency in both branches, having regard to their constantly-increasing importance in their bearing on social and commercial life."

MAGNETIC OBSERVATIONS IN THE POLAR REGIONS.—According to the *Standard* an International Polar Conference was opened a few days ago at St. Petersburg for the purpose of settling the arrangements in regard to the expeditions about to be equipped for investigating the magnetic and meteorologic conditions prevailing in the Polar regions. England is to contribute to the enterprise by the erection of an observatory in Northern Canada; America will erect stations at Point Barrow and in Lady Franklin Bay; Denmark in Upernavic, Russia at the mouth of the Lena and at Nowaja Semlja; France at Cape Horn; Norway at Bosskop; Sweden at Spitzbergen; and Austria on the Island of Jan Mayen.

ELECTRIC LIGHT FOR DUNDEE.—At a recent meeting of the committee appointed by the Gas Commissioners to consider the question of electric lighting, the committee unanimously expressed their opinion that the introduction of the electric light in Dundee should not be left to any private company or speculative promoters, but should be taken up by the Gas Commission, and they instructed the clerk to communicate with other towns and gas companies for information as to their views and intentions, and also for their suggestions, after which the committee should meet again. In the meantime, the manager was instructed to devise means for making experiments with the electric light at the Dundee Gas Works.

ELECTRIC LIGHT AT NORWICH.—A Norwich contemporary says:—"On Tuesday evening, the 16th of August, the Market Place was for the first time lighted by means of electricity. Only two lamps were lighted, one on each of the tall poles erected for the purpose, and the light emitted was of the most brilliant character. The lamps used are certainly most effective, and at such a height from the ground as to obviate any annoyance to the eye, while there was an almost total absence of that disagreeable flickering which was at first so troublesome. The experiment was repeated on Wednesday evening, and may be regarded as entirely successful. It is to be hoped that it will ere long be tried on a more extensive scale; indeed, we believe it is intended to light up Post Office and St. Andrew's Broad-streets by means of the Swan lamps, and if this is successful the practicability of the application of electric lighting to the Norwich streets will be fully demonstrated." Messrs. R. E. Crompton and Co. are the contractors for this installation.

AN INTERNATIONAL MEETING OF ELECTRICIANS.—The Chambre Syndicate d'Electricité has organised an international meeting of electricians to take place in Paris between the 1st and 15th of October. *La Révue Industrielle* says:—"The congress will treat of theoretical questions; the meeting will lend itself by preference to the purely industrial and commercial side of the question. It will study the ways and means necessary to enable electricity to take the place it merits in our advanced civilisation." The president of the Chambre Syndicate d'Electricité is M. H. Fontaine, whilst the president of the organisation committee is M. Armengaud, jun., to whom all papers, &c., intended to be communicated at the meeting should be sent before the 15th September, at No. 10, Rue de Lancry. M. Boistel has been appointed treasurer of the meeting, and to him the subscriptions, amounting to thirty francs for each member, should be addressed. These subscriptions are intended to defray the cost of publishing the papers that may be read. The meeting will be open to all comers without distinction.

AN ELECTRICAL VOTE RECORDER.—Amongst the exhibits at the National Industrial Exhibition in Milan is an electrical voting apparatus, designed by Signor Roncelli, a member of the Italian Parliament. The idea is simply as follows:—Each member of the House has in front of him a metal plate bearing his name. This plate is furnished with three metal buttons, marked respectively Aye, No, and Abstain. This plate is in connection with a central printing apparatus, which prints in three separate columns the ayes, noes, and abstainers, according as the members depress their respective buttons. A fourth column marks the absentees. At the

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moment of recording each vote, a number corresponding with the number of the vote appears, and thus the total can be seen at a glance. By this method members are enabled to vote and keep their seats, besides the saving of time which is thereby effected. We are not aware that this system is in use anywhere at the present moment, but something of the same kind might prove of great service in the way of preventing the lamentable waste of valuable time which so frequently takes place in our own House of Commons.

THUNDERSTORMS.—Severe thunderstorms are reported as having taken place in various parts of the Midlands and the North of England last week attended with more or less of damage to property and injury to life. At Belper, in Derbyshire, the lightning struck several houses, damaging the chimneys, firegrates, and articles in the rooms. Several narrow escapes are recorded, and more than one person seems to have been temporarily paralysed by the current. At Alnwick, in Northumberland, a tall chimney belonging to Messrs. Mason Bros'. tannery was struck, and partially demolished. The lightning appears also to have caused some consternation in the ironfoundry yard of Mr. Bowey on the opposite side of the street. It is said to have knocked down a workman and overturned some wheel-patterns upon him, and at the same time to have set a crane in motion, which struck another of the workmen, without, however, injuring him severely. The storm passed over South Durham, and interfered greatly with telegraphic communication. In Lancashire, also, it was very severe. At Warrington, a house in Winwick-road was struck, the lightning knocking down the chimney, and passing through the roof, scattering the contents of the room below all about. No one appears to have been hurt, however. In the early part of this week the southern half of the Midlands was visited by severe storms. At Worcester a house was struck and set on fire, and two people were knocked down and injured by the lightning. At Atherstone and Nuneaton telegraphic communication was interrupted for many hours. Wolverhampton appears also to have been visited by a storm.

FIRE BALLS.—A correspondent of *Science* (New York) writes in a recent number of that paper, under this heading, as follows:—"One sultry summer day at sea, I was lying on the deck of a small schooner, watching in the sky the gathering clouds of a sudden and violent thunder shower. I was looking over the mainmast, whose top was in the centre of my field of view. As the first scattered drops of rain began to fall, and in advance of any lightning or thunder, there appeared upon the top of the mast a brush of fire, remarkably like that which is often produced on a small scale in electrical experiments. This brush shone very distinctly against the heavily overcast and darkened sky, and it looked about as large as the hand of a half-grown child, with the fingers spread moderately apart. After one or two seconds it seemed to change into a ball of fire, of smaller size but greater intensity, and distinctly round in outline, which glided smoothly down the surface of the mast and across the wooden deck, until it passed over the stern of the boat, and entered the water with an explosion not unlike the report of a large pistol. There was no lightning rod upon the vessel, but the wood of the mast and of the deck was quite wet by the time the ball passed over it. The electrical disturbance did not approach the mast with a visible flash, and the sound of the explosion, the only sound noticed, was decidedly from the direction where the ball entered the water. The ball left the mast in a line at right angles to a tangent at the point of departure, while the nearest course to the sea would have been in the direction of the tangent; but having once commenced to cross the deck it took a perfectly straight course. The wood over which it passed was slightly discoloured in several places, but not at all charred."

A MODIFICATION OF THE PLANTE BATTERY.—M. de Pezzer has constructed a modification of the secondary battery of M. Planté, in which he has endeavoured to obtain a maximum charge with a minimum quantity of lead. He uses for the negative electrode, a very thin lead plate of about $\frac{1}{3}$ mm. thick, the positive plate being no more than 2-3 mm. thick; projecting portions of the plates which serve for connections are, however, somewhat thicker. Besides this, M. de Pezzer has effected another modification, based upon experiments lately made by him. He took two identical couples, each formed of two plates of lead of the same thickness, one of which, however, had twice the surface of the other. He then charged the couples by the same means, but arranged them so that in one case the plate with the larger surface should be the positive element, and in the other, the negative. By this means he discovered by repeated experiments that the couple in which the plate with the large surface was the negative electrode accumulated more electricity than the other couple. The discharge of both couples was made to pass through the same resistance, which comprised a galvanometer, and it was seen that the duration of the discharge was sensibly proportional to the charge. In four consecutive experiments the discharge of the couple with the large surfaced negative plate lasted at least an hour, whilst that of the couple in which the positive plate had the larger surface lasted but half an hour. Finally, a couple formed of two plates equal in size to the two large ones of the above mentioned couples gave an inferior result to that of the couple with the large negative plate. With these results to guide him, M. de Pezzer modifies the construction of the secondary battery as follows:—Preserving the sizes of the plates given above, he makes the surface of the positive half as big as that of the negative plate, at the same time making a certain number of incisions in the former. The arrangement of the plates is the same as ordinarily; but, according to M. de Pezzer, his modification is capable of storing up the same quantity of electricity as a much heavier battery constructed in the usual way. *La Lumière Electrique* says that M. de Pezzer promises exact figures on this point soon.

THE ELECTRIC LIGHT IN LIVERPOOL.—A correspondent of the *Engineer* writes as follows:—"In passing through Liverpool I paid a visit to the works of the British Electric Light Company, where they have erected by far the largest generating station for electric lighting purposes which has yet been constructed in this country; and by the courtesy of the manager, the Hon. R. Brougham, I had an opportunity of inspecting the Company's plant. The Company have secured the contract for lighting the principal streets, and after successful experiments, which have recently been made, they are now erecting sixty-three lamps, which will cover about three miles of the most central thoroughfares. The lamps are carried on iron supports at varying heights of from 20ft. to 50ft., according to circumstances, a portion of them being connected by underground circuits, and the remainder by ordinary copper wires carried overhead. The generating station is situate at the Princess Docks, and is at present fitted up with two of Marshall's 20-horse portable engines, and one of Ransome and Sims's engines of similar capacity. There are three sets of counter-shafting driving eight generating machines. Six of these are the H. Gramme machines, the largest size yet made, each capable of producing fifteen separate lights of 2,000 candle-power, and the remaining two being small machines

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for feeding. One 20-horse engine is sufficient to give the driving power requisite for the sixty-three lamps, but a second engine is provided for emergency in case of accident, and the generating machines are also in duplicate, with an arrangement for instantaneously switching on a spare machine in the event of a breakdown or the lights in any particular circuit going out. The machines and driving gear are all set upon 4ft. 6in. beds of concrete, and altogether four engines are being put down to provide for the further development of electric lighting in the district. The furthest lamp is nearly a mile and a half from the generating station, but in the event of the system, which at present is in the experimental stage, being extended, a nearer basis for the various circuits would be provided, and it would also seem necessary that these circuits should be connected underground throughout, as a still further multiplication of overhead wires through the streets would be an objectionable feature in electric lighting."

Earth Currents.—With reference to a paper on this subject read before the Society of Telegraph Engineers by Mr. A. J. S. Adams (see *The Electrician*, Vol. VI., Nos. 1, 5, 12, 14, 15, 18), Mr. Spagnoletti writes to the Society's *Journal* (June number) as follows:—"Referring to Mr. A. J. S. Adams' paper on earth currents, read on the 10th of February last, and the discussion thereon, in which the question 'of the effects of the flow of water against or under an insulated wire' were discussed, I gave on a previous occasion the results of some experiments I had tried; but, as they were not to my mind satisfactory, I had further tests made, and now give you the results of the same, which, in my opinion, quite disposes of the question, and gives an instructive result. A No. 7 G.P. wire, 18 copper, was laid across the Thames at Reading. The current at this spot was running about 14 miles per hour, so the place was well selected for the trial.

Wire in the Water.

	Deflection.
Wrought-iron earth plates at both ends ...	24 degs.
Galvanised „ „ „ ...	15 „
Copper „ „ ...	Nil.

Wire out of the Water.

With the same earth plates, results were the same as above. Again.

Wire in Water.

	Deflection.
With a wrought-iron earth plate at one end and a galvanised „ „ at the other end	30 degs.
Wrought-iron at one end and copper at the other	75 „
Galvanised iron at one end and copper at the other.....	79 „

Wire out of Water,

and with the same arrangements of earth plates, results the same as above.

A telephone was then put into the circuit, and a faint rumbling noise was heard, but this did not in the least interfere with the transmission of articulate sounds. Thinking that as iron earth plates always produced a current, and that as the wire on which the foregoing experiments had been made had been of copper, I had a No. 16 galvanised iron wire run up about 70 yards or so, well insulated, and, on trying this wire with the same earth plates as were used before, the following results were obtained, the same astatic galvanometer being used:—

	Deflection.
With copper earth plates at each end	Nil.
Galvanised iron rods at each end	54 degs.
Wrought iron rods at each end	38 „

These experiments conclusively show no electrical current is produced in the wire by a current of water against, over, or under it, and also clearly point to the fact that copper is the proper material to use for earth plates, whether iron or copper 'line wires' are used. Those who are carefully watching the effects of earth currents should use no other, or they may get results from chemical action which may very easily mislead, and be mistaken for natural earth currents."

Parliament and the Aggrieved Telegraphists.—We were unable, through pressure upon our space, to give a full account of the discussion in the House of Commons, arising out of the estimates for the Postal Telegraph Service, voted during the small hours of Wednesday morning last week; but the incidents of the debate were better deserving attention than the reports furnished by most of the newspapers would lead us to suppose. As an example of their inaccuracy, we may instance the *Standard*, which reported Mr. Fawcett to have said, in proof of the popularity of the service, that for forty situations as "senior telegraphists" recently competed for at Edinburgh, there had been 420 applicants. According to *The Times* report, what he really did say was, not senior telegraphists, but "female telegraphists," which is a far more probable account of the matter. It is no proof of popularity, perhaps, that 420 girls are ready to learn a business, but it would be proof of extreme unpopularity if 40 senior clerkships were vacant, to say nothing of the impossibility of filling them by competitive examination from outside. Moreover, a great deal of reassuring information was elicited on the occasion in question. Mr. Fawcett stated that the clerks had been too precipitate in coming to conclusions as to the dimensions and scope of his much criticised scheme. We can quite understand how this has happened. The clerks have inferred that their places on the scales would be the same as before, the only advantage being in the prospective rises. But the facts seem to be that the apportionment of the classes has yet to be arranged, and that it is, therefore, quite premature for any clerk to say whether or not he will be shifted into a higher class. The number of appointments of the higher grades will be largely augmented, so that not only are the chances of immediate promotion greatly increased, but the prospects of rising out of the inferior ranks will be improved. The vexed question regarding the apparent injustice done the metropolitan clerks outside the Central station was likewise gone into. Mr. Fawcett gave reasons, which to a certain extent were satisfactory, for treating the staff at the Central establishment exceptionally, chiefly because of their arduous night duty, from which the other metropolitan offices are mostly exempt. Still, however, there is some force in the plea of the latter that they have undergone the same examination, and entered under the same conditions as the clerks at the Central office, and that it was chance, not choice, that relegated them to the subordinate offices. They will find some consolation, however, in the announcement made by Mr. Fawcett that the alleged difference between the maximum scales of the two branches does not really exist; and a point was scored by the Postmaster-General when he showed that at the very moment the memorial setting forth this grievance was being circulated to obtain outside influence, he, unsolicited, was setting the matter right. On the whole, we think that the result of the debate was satisfactory, and we hope that the scheme when it becomes generally applied will be equally so. Lord F. Cavendish, as usual, did his maladroit best to spoil the good impression. We begin to suspect his lordship of being the author of the famous, or as some people regard it, infamous, Treasury minute.

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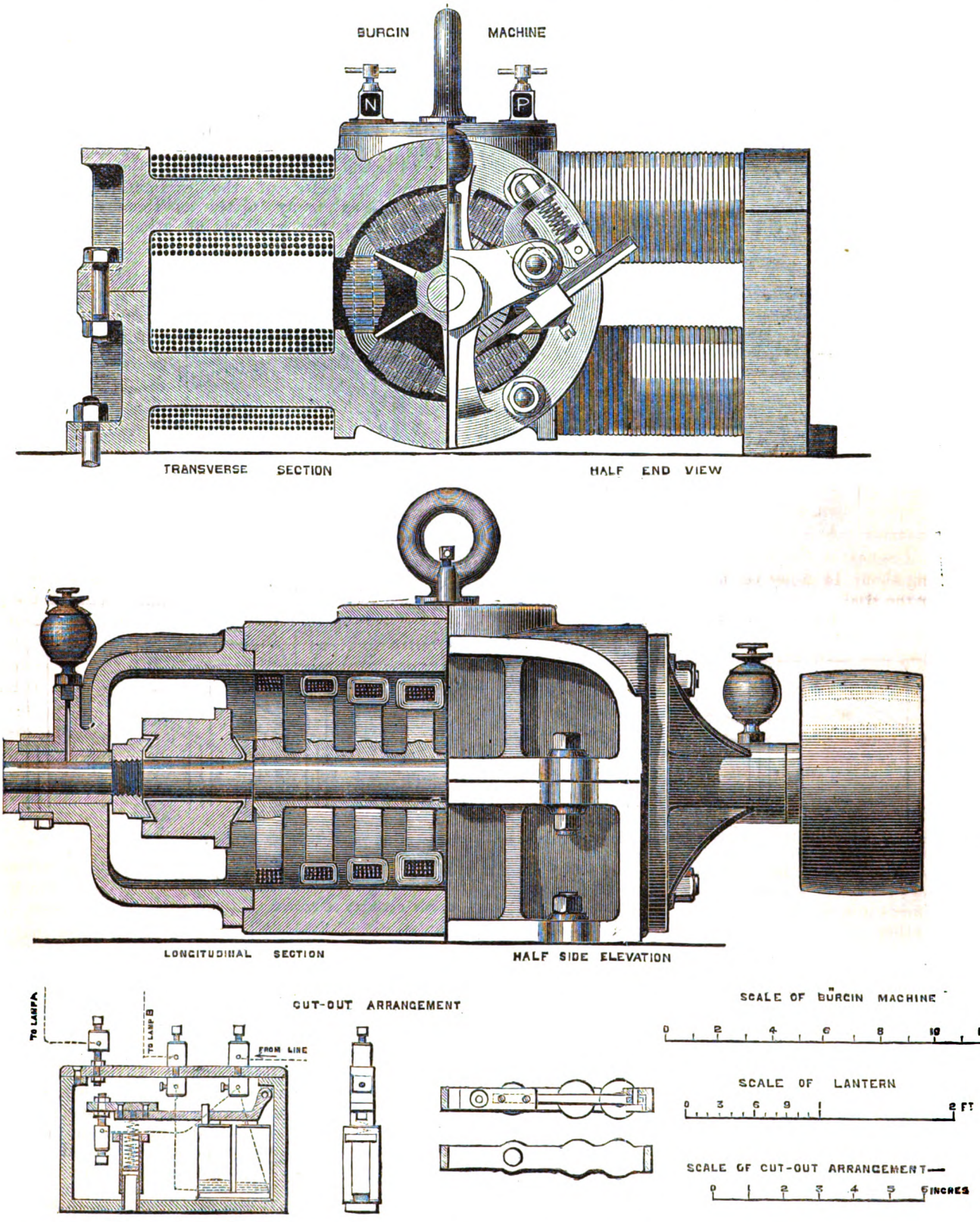
THE CROMPTON ELECTRIC LIGHT AT KING'S-CROSS.

We have often referred to Mr. Crompton's energy and success in applying his arc system of electric lighting; but we doubt if any of his previous work has been so thoroughly satisfactory as that just completed at the King's-cross station of the Great Northern Railway. The station, as is well known, consists of a departure and an arrival side. The departure bay is 105ft. wide, the arrival, together with the adjoining cab-rank, 145ft. wide, with a length of 880ft., and an extreme height of 72ft. The area to be lighted is, then, equal to $250 \times 880 = 220{,}000$ square feet, and to effect this object 12 Crompton arc lamps are used, six on each side of the station. Outside the building, at the corners of the front, two larger lamps are placed. As this installation is one of the most complete, and, judging from our own experience of the light, one of the most effective and economical, we shall describe the apparatus somewhat in detail.



Engine.—The motor for driving the dynamo-machines is a semi-portable engine, constructed to special designs by Messrs. Marshall, of Gainsborough. A similar engine is

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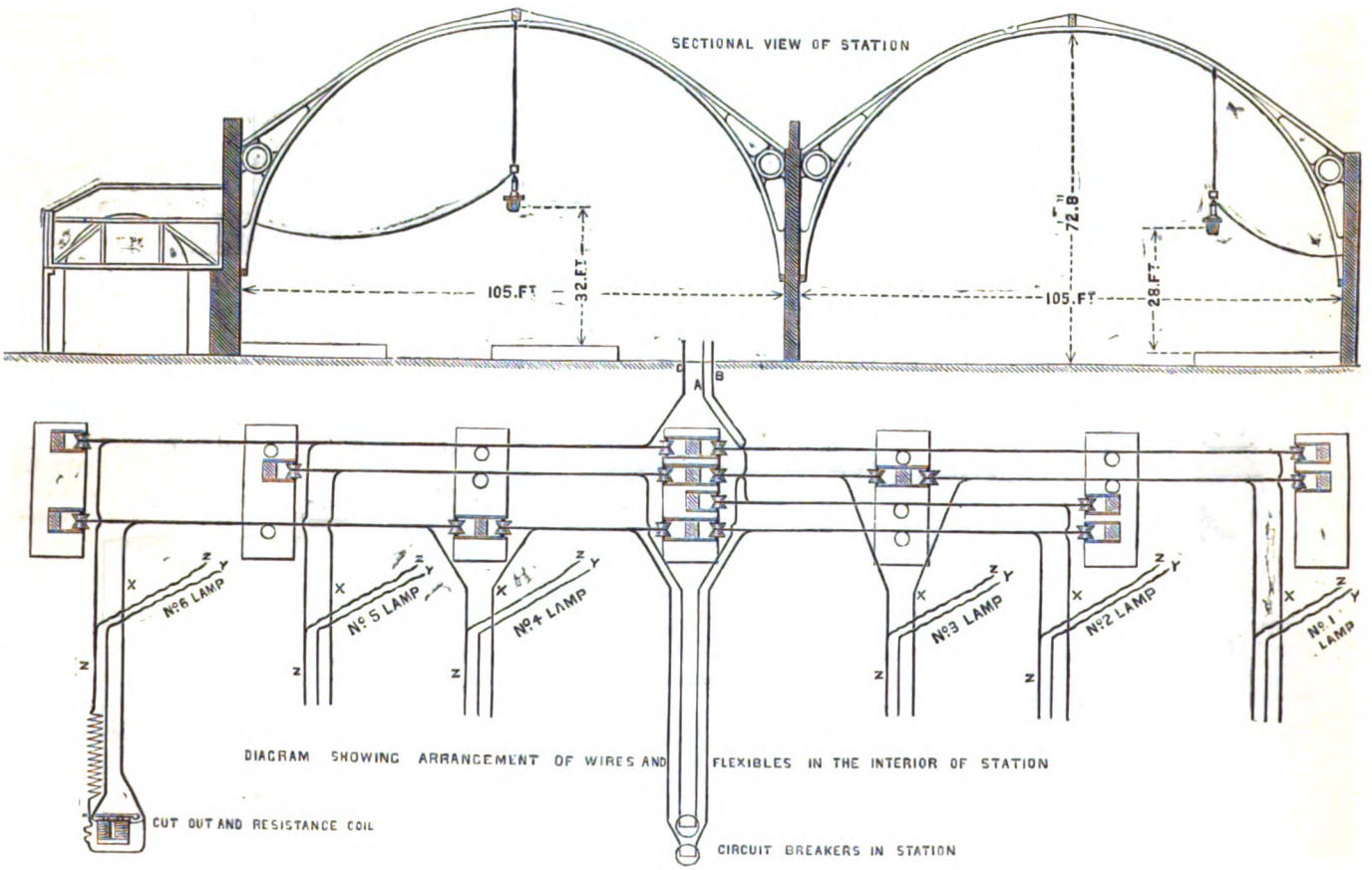
shown at the Paris Electrical Exhibition by Mr. Crompton. There are two cylinders 7in. and 11·25in. diameter, both thoroughly steam jacketed. The high pressure cylinder has a slide valve, the cut-off of which is controlled by a Hartnell governor. As we shall have more to say of the engine at Paris in our exhibition report we merely state now that the engine at King's Cross is 12 h-p nominal, but is capable of working up to 35 h-p. When all the lights are going it is found that about 29 h-p indicated is required, as may be gathered by any capable man interested in the question taking diagrams, an operation which Mr. Crompton is always willing to allow. The power required extraneous to the interior lights, is that absorbed by the engine gearing, say, 3·5 h.-p., by the exterior lights, say, 3 h.-p. each, and by a number of Swan incandescent lamps used to light the engine room, say, 1·5 h.-p., leaving 18 h.-p. absorbed by the 12 lamps, or 1·5 h.-p. per lamp. To guard against accidents a second engine is to be put down. The dynamo-machines are driven by means of an intermediate shaft, and in order that either engine may be put into gear



instantly, Mr. Crompton has utilised the Addymans friction clutch, so that should the occasion arise the work can be shifted from engine to engine without putting the lights out.

The Dynamo Machines.—In *The Electrician*, vol. V., p. 172, we briefly noticed a then recently patented machine. Since then many of these machines have been built by Mr. Crompton, and severely tested. They are generally known as the Bürgin machine, and at King's Cross the current is supplied by five of this pattern, the field magnets of which, in order to obtain greater steadiness, are excited by two small Gramme machines. The exciting current is about 12 webers, and the effective current through the inside lamps is about 17 webers, and that through the outside lamps about 24 webers. Two views are given of this machine, the method of constructing the armature being clearly shown. It consists of a series of elements, each made up of a core and coils. The core is of iron tape, upon which the coils are wound as shown, the method of winding bringing as much wire as possible in the most advantageous position relative to the field magnets. The armature of a Bürgin three-light machine has 48 coils, of coarse copper wire, 48ft. long, and ·065in. diameter. The weight of this wire is 25lb. The electro-magnets have four coils of wire, each 760ft. long, with a total weight of 140lb. The resistance of the armature, brush to brush, is 1·6 ohms, of the magnets 1·2 ohms, giving a total resistance between terminals of 2·8 ohms. The electromotive force is given as 195 volts, with 1,500 revolutions per minute, and 206·5 volts, with 1,600 revolutions through 13·16 ohms resistance. The speed of mean diameter of wire coils on armature through the magnetic field at 1,500 revolutions is 2,550ft. per minute. The total length of the machine over spindle is 2ft. 10in., height to terminals 1ft. 1·5in., breadth 2ft. 4in., and it has a weight of about 6·5cwt. The core or ring of each element is supported by arms, radiating from a hub upon the shaft, of non-magnetic material. The coils are successively connected and the last coil joined to the first, thus forming a single closed circuit. At each joint a connection is made with the corresponding plate of the commutator, which thus consists of as many plates as there are coils. The diagrams show the method of attaching the brushes, the construction of the field electro-magnets, and, in fact, the machine generally. A large number of experiments as to the efficiency of the machine have been made, but we restrict ourselves at present to those made at King's Cross. On July 12th, with 1,480 revolutions per minute, 3 lamps in circuit, a current of 16 webers was obtained at the expense of 1·49 h.-p. per lamp. On August 6th, under similar conditions, a 16 weber current was obtained with 1,460 revolutions per minute, and on the same day, with 1,340 revolutions, a 14·8 weber current, at an expense per light of 1·37 h.-p. The resistance through which the current worked was experimentally ascertained. At King's Cross the circuit of 3 arcs was carefully balanced with iron wire, and that measured by Wheatstone's bridge. It was found as the mean of about 20 experiments that the resistance of lamps, carbons, and arcs may be taken as equal to 9·36 ohms, the carbons being Carré's carbons 13mm. diameter, and the lamps adjusted to their normal arc. The total resistance of each 3-light circuit is therefore 13·26 ohms, made up of lamp resistances 9·36 ohms, conducting wires 1·10 ohms, and machine resistance,

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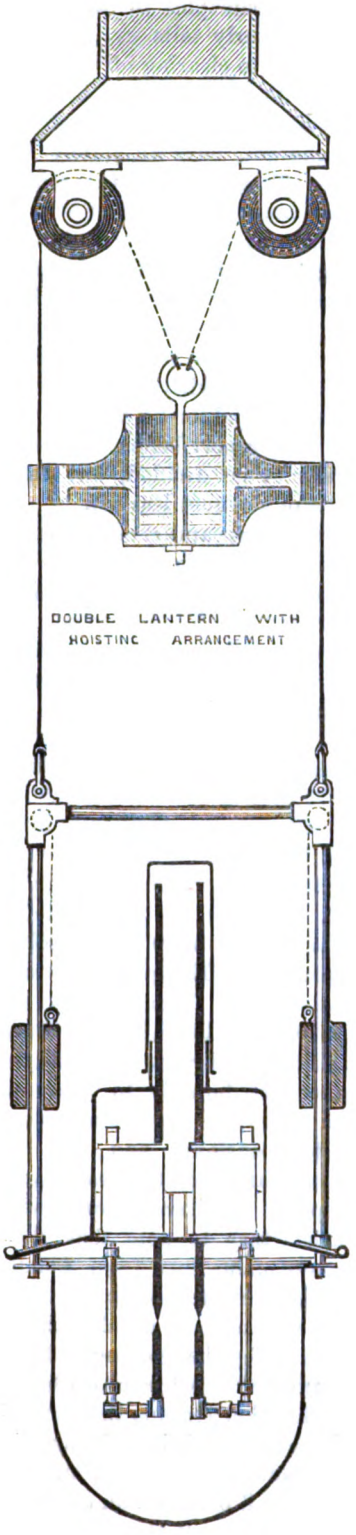
terminal to terminal, 2·80 ohms. Deducting 1·5 ohms as the resistance of the lamps and carbons, the nett resistance of the arcs is equivalent to 8·76 ohms, or about 65 per cent. of the whole, and using these figures it seems that about 63 per cent. of the h.-p. appears as useful effect in the arc.

ARRANGEMENT OF WIRES, &C., IN THE STATION.—Our illustrations show a sectional view of the station with the



DOUBLE LANTERN WITH HOISTING ARRANGEMENT

lamps in position, also the arrangement of the wires of one circuit in the interior of the station. The twelve lamps in the inside of the station are placed in series of three each, forming four circuits, two in each bay. The lamps in two circuits are placed alternately, so that should any accident happen to one circuit the alternate lamps only are affected. It is found that the lamps of one circuit give sufficient light to carry on all necessary work without difficulty. The leading wires of the two circuits A and B are brought from the engine room through the roof, C forming the common return wire. The line wire *x* leads to the lamp through a cut-off arrangement, and by the wire, if under normal conditions; otherwise, through the coil and wire *z*. The automatic cut-off arrangement is simple and ingenious. It is intended to provide a remedy in case of accident to any one lamp. The line wire *x* is connected to the binding screw as shown. The current ordinarily passes from this binding screw through the coils of the electro-magnet to the binding screw connected to lamp B. The current passing through the coils causes the core to attract the armature as shown, and counteracts the effect of the spring. At the further end of the armature is a contact screw, directly connected with the binding screw of the line wire as shown by the dotted line. Supposing, then, the lamp B fails to act, the electro-magnet ceases to attract the armature—the spring presses the armature upwards and causes the contact screw to make contact with a binding screw connected to lamp A. The current then passes direct from the terminal on one side to the terminal on the other, missing altogether the centre terminal. A coil as shown at the left hand of diagram representing wire connections is now brought into the circuit, and this coil has a resistance equal to that of the lamp thrown out of the circuit, so that the total resistance of the circuit remains practically unaltered. An arrangement is also made so that an attendant in the station can cut out either circuit as required. The outside lamps have a circuit to themselves, and as there are only two lamps in this circuit the intensity of the lights is equal to 6,000 candles as compared with the 4,000 candles of each of the interior lamps.

The lamps are placed about thirty feet above the platform, and each lamp is hung with a counterpoise as shown in the diagram, so that it can be hauled down, examined, and replaced in a few seconds. The lower part of the cup shaped glass of the inside lamps is ground, so as only to be semi-transparent. No reflectors are used, as the light naturally radiated downwards, is sufficient for all purposes.

It is not necessary to enter into details of the lamp itself, as that was described and illustrated in *The Electrician*, vol. iv., p. 273. The engine room is lighted by some of Swan's incandescent lamps, and we believe the authorities of the Great Northern Railway are contemplating another innovation, in the shape of lighting a train by means of the electric light, which, if successful, will be one of the greatest boons that can be conferred upon the travelling public.

COST OF ELECTRIC LIGHTING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Can you inform me whether there is any data of the cost per hour of electric lamps? I saw some time since a statement that the Metropolitan Board of Works had renewed their contract for the Thames Embankment lamps at 1½d. per hour, but I have also seen 4d. and 7d. per hour mentioned as the cost per lamp. I suppose the cost will vary with the power of the lamp, but would like to be informed if that cost has been ascertained, and what it is?

August 20, 1881. J. F.

TELEPHONE RECEIVERS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: As the persons interested in the "Bell" telephone patent are again claiming that their's is the only practically useful telephone receiver, will you permit me to direct attention to the electro-magnet receiver, described by me in your issue of June 26th, 1880. This receiver, when used with a good microphone transmitter, such as the cup-and-ball microphone, affords a means of communication quite equal to that obtained by the use of the "Bell" instruments. Neither the cup-and-ball microphone nor the electro-magnet receiver are patented, and they can be made and used by anyone.—Yours, &c.,

5, Pump-court, Temple, E.C. H. B. T. STRANGWAY.

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THE ELECTRICIAN.

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THE POSTMASTER-GENERAL'S REPORT.

Although that portion of the Postmaster-General's Report which relates to the telegraphs is not adorned with the facetiæ peculiar to the postal section of it, there is no lack of interesting matter in this year's issue deserving of comment. Patrons of the telegraph do not send messages without addresses, nor have the public yet acquired the "habit" of forwarding dead rats or mouldy sausages by electric wire. The facilities of the post card for openly insulting a neighbour have not yet been extended to the telegram, and the days when people crowded the wires with shillingsworths "just for the fun of the thing" have long since passed away. When sixpenny telegrams are inaugurated—we believe that is the correct phrase—no doubt much comic matter of the postal kind will be afforded the daily leader writer; but those pleasant days are still in the uncertain future, for we may state at once that the Report says nothing at all about sixpenny telegrams. Those reformers, however, who are desirous of introducing this much-talked-of, if little-needed, boon will note with satisfaction that the finances of the telegraph service are in a better condition than they have ever been before, and that for the first time since its administration by the State the net revenue of the system has exceeded its liabilities. Our enthusiasm is a little damped, perhaps, by the reminder which the report lets fall that, unlike the Post Office proper, the Telegraph has a large capital account; in other words it subsists on borrowed money. The revenue of the older service, after paying its expenses, is so much clear profit; whilst the profit of the affiliated service goes to pay the interest on its purchase money. On the principles of the parent branch, as Mr. Fawcett very properly tells us, all the available receipts should be devoted to clearing off the debt. The Post Office has always paid its way sooner or later, and its expenditure on public buildings, as well as its temporary losses through reduction of charges, have ultimately been covered by the earnings. The Telegraph, on the other hand, having been acquired at an immediate outlay of over ten millions sterling, its receipts hitherto have been more than swallowed up in merely paying for the loan. On commercial principles anything in excess of what is needed for that purpose would be available for reducing prices; and it is therefore a question whether the commercial or the traditional view of such surplus shall prevail; whether, in fact, it shall go towards paying off the principal, or be devoted to a further reduction of the tariff. The report before us gives no hint of how that point is likely to be decided, but this is how the matter stands, and there we must leave it.

The satisfactory appearance of the balance-sheet at the end of the last financial year is not due to any exceptional prosperity or abnormal swelling of the receipts, but is the result of a steady growth which has been so uniform that its future may now be predicted almost with certitude. From the date of the transfer to the present time the increase in the number of telegrams has never slackened. In 1871-2 they numbered 9,850,177; the next following year there was an increase of nearly two and a half millions; in 1874 the total had reached 15,535,780; after that the rate of increase continues at about two millions annually until the year 1877-78, when certain Press messages not previously included in the return bring that year of depression up to the usual average. For 1880-81, the year just completed, the grand total is 29,966,965, or rather more than treble the number forwarded ten years ago. The gross revenue has grown in much the same ratio, rising from something less than a million sterling in 1870-1 to £1,847,726 in 1880-1. The net revenue, however, has fluctuated very materially during that period, a circumstance attributable to heavy claims having been settled from time to time and at uncertain intervals in respect to pensions, and the still heavier items awarded as arrears to the railway companies. These demands appear to have now been all cleared off, and it is satisfactory to note that the cost (£75,000) of erecting the new main lines from London to towns in the North of England and to Scotland has been defrayed out of the current year's income; as also the expenditure (nearly £40,000) incurred by the opening of 107 new offices, bringing up the total number of offices to 5,438.

For these and other reasons the expenditure has been exceptionally high; nevertheless the margin of profit reached the respectable sum of £328,878, sufficient not only to pay the full interest at 3 per cent. on capital, but to leave a real surplus of £2,462 towards the cancelling of debt.

Turning to some minor details of the report we observe with no surprise that within the past two years the rental of private wires has increased by about £11,000 annually. The extended demand for special wire accommodation is hardly less conspicuous, the rental derived from this source being now £85,031, compared with £76,269 in 1879-80. The increase in the value of telegrams forwarded for other Govern-

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ment departments, and for which no payment is made, is perhaps not quite so satisfactory. The value of these messages in the past year actually amounted to £19,478, a sum which ought in fairness to be charged to the several departments concerned.

We miss from this report any statistics relating to the mileage and plant of the telegraph service; but the staff of *employés*, exclusive of 225 pensioners, is given in detail as under:—

STAFF EMPLOYED EXCLUSIVELY ON TELEGRAPH DUTIES.

Chief engineers and other superior officers			11
Clerks, telegraphists, &c.:—			
	Male.	Female.	
London	2,033	904	
Provincial	3,031	652	
	5,064	1,556	
			6,620
Messengers			4,736
			11,367

Mr. Fawcett's observations upon the late dispute between his department and the telephone companies is deserving of notice, and with this quotation we may fittingly bring our remarks to a close:—"On the 20th of December an important decision of the Exchequer Division of the High Court of Justice defining the rights of the department in connection with telephones was given against the companies who had established exchanges. As, however, they were apparently under the belief that they had infringed no law, I held myself ready to meet them with liberal terms, and, after much negotiation, concluded an agreement which, while protecting the interests of the public, afforded reasonable advantages to the companies concerned. The system of telephonic intercommunication is, therefore, now being extended partly through the agency of companies and partly by the Post Office. The department has in course of completion telephone intercommunication systems at Swansea, Glasgow, Greenock, Hull, Manchester to Liverpool, Newport to Cardiff, Leicester, Sunderland, and other towns, and is receiving applications from many quarters."

THE FAURE BATTERY AGAIN.*

"Who will deliver us from the Greeks and the Romans?" says Berchoux in his *Gastronomy*. We would say the same of the Faure battery; but we read in English papers certain articles which oblige us to return to this subject. Thus Mr. Desmond FitzGerald has devoted to the Faure battery, in the last number *The Electrician*, an article in which he takes us to task in order to tell us that the English are perfectly *au courant* with scientific discoveries, and are in a position to appreciate them. We are quite aware that England is the country which contains the most electricians, and electricians of the first order. This we have more than once stated ourselves; but, in relation to the Faure battery, we adhere to what we have said; and what we have read in certain English journals shows either that the writers were unacquainted with the Planté battery, or that they must have had *very badly constructed ones*, since all that can be said of the Faure battery is applicable also to the Planté battery, even including the calculations and the duty indicated by Mr. FitzGerald. The two batteries, in fact, are in our view identical; and we should be glad if Mr. FitzGerald would point out to us in what respect they differ with regard to the reactions produced. We stated that even the original form of the Planté battery had been retained; we think that nobody will deny this; and we might say the same of the rectangular form that has recently been adopted; for M. Planté had also constructed batteries of this kind, which he soon rejected. We repeat that the Faure battery is but a Planté battery, with an addition which brings it more promptly into working action (*avec un intermédiaire que en rend plus prompte la formation*); and if we may accept certain experiments made by persons who have constructed batteries of this description, the layer of lead produced by the reduction of the red-lead exhibits, after a certain period of working, a very considerable resistance between it and the plate serving as electrode, which resistance diminishes in great measure the current supplied. This it was that discouraged M. Tchikoleff and M. Planté himself when some years back they attempted, in order to produce more quickly the layers of finely-divided lead, to use materials capable of depositing such layers at once. For red-lead is not the only substance that produces such effect, and the rapid production of the "Tree of Saturn" shows that it is readily possible to obtain plates of lead under the required conditions, which, it may be observed, are those which exist in the case of the platinised platinum plates of the Smee battery.

* Translated from *La Lumière Electrique*.

THE CONGRESS OF ELECTRICIANS.

BELGIAN MEMBERS.

The following gentlemen are appointed to represent Belgium at the International Congress of Electricians, by an order of the Minister of the Interior, dated the 7th of August, viz.:—

M. P. Van den Kerchove, Senator, of Ghent, as President.
M. H. Bergé, Chemical Professor at the University, Brussels.
M. J. Banneux, Chief Telegraph Engineer of the State, Brussels.
M. A. Barlet, Head of the Lighting and Warning Service of the State Railways, Brussels.
M. A. Bastings, Doctor of Medicine, Brussels.
M. E. Bède, Engineer, Brussels.
M. A. Belpaire, Director of State Railways, Brussels.
M. F. Delarge, Director of State Telegraphs, Brussels.
M. A. Flamache, Engineer to the Directorate of State Railways, &c., Ghent.
M. F. Fourcault, Director of the Compagnie des Bronzes, Brussels.
M. E. Gerard, Assistant Engineer of State Telegraphs, &c., Brussels.
M. P. Gilbert, Professor at the University, Louvain.
Mlle. A. Gloesener, of Liége.
M. L. Gody, Captain of Artillery, Professor of Chemistry and Physics at the School of Arms, Brussels.
M. Z. Gramme, of Paris.
M. J. Jaspar, of Liége.
M. Th. Jouret, Professor of Chemistry at the Military School, Brussels.
M. P. le Boulengé, Colonel of Artillery, Liége.
M. Ch. Malevé, Captain of Engineers, Commander of the Field Telegraph Train, Brussels.
M. H. Maus, Member of the Royal Academy of Sciences, &c., Brussels.
M. G. Montefiore-Levi, C.E., Brussels.
M. C. Montigny, Member of the Royal Academy of Sciences, Brussels.
M. A. Neujean, Chemical Engineer, Liége.
M. L. Perard, Professor at the University of Liége.
M. Ed. Rau, C.E., Brussels.
M. L. Rommelaere, Chemist, Brussels.
M. C. Rousseau, Professor at the Free University, Brussels.
M. L. Somzée, Honorary Engineer of Mines, Brussels.
M. H. Valérius, Professor at the University of Ghent.
M. F. van Rysselberghe, Meteorologist of the Royal Observatory, Brussels.
M. H. Witmeur, Civil and Mining Engineer, Brussels.

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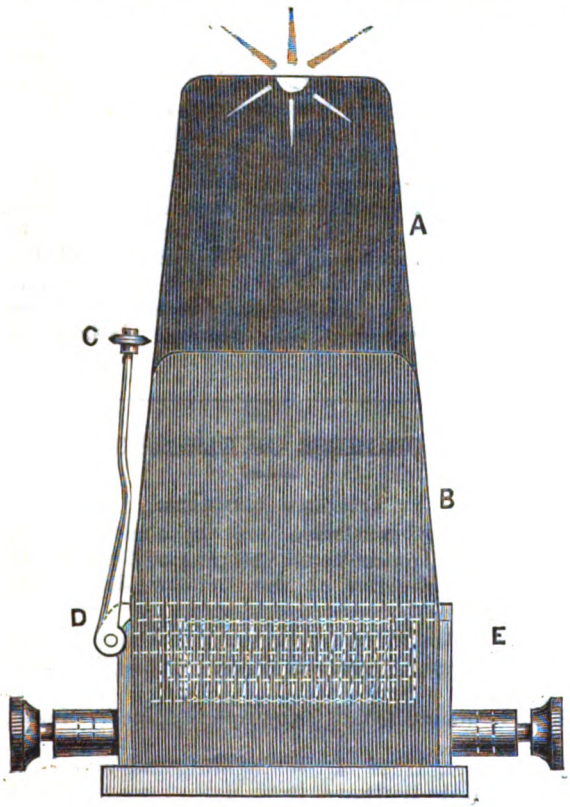
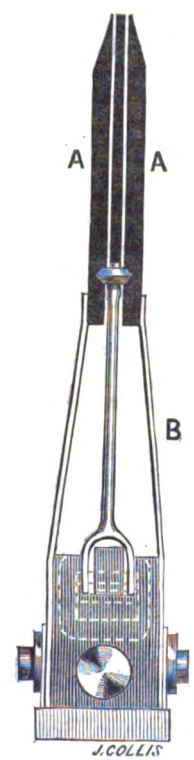
THE ELECTRICAL EXHIBITION AT PARIS.

Electric Light Apparatus.

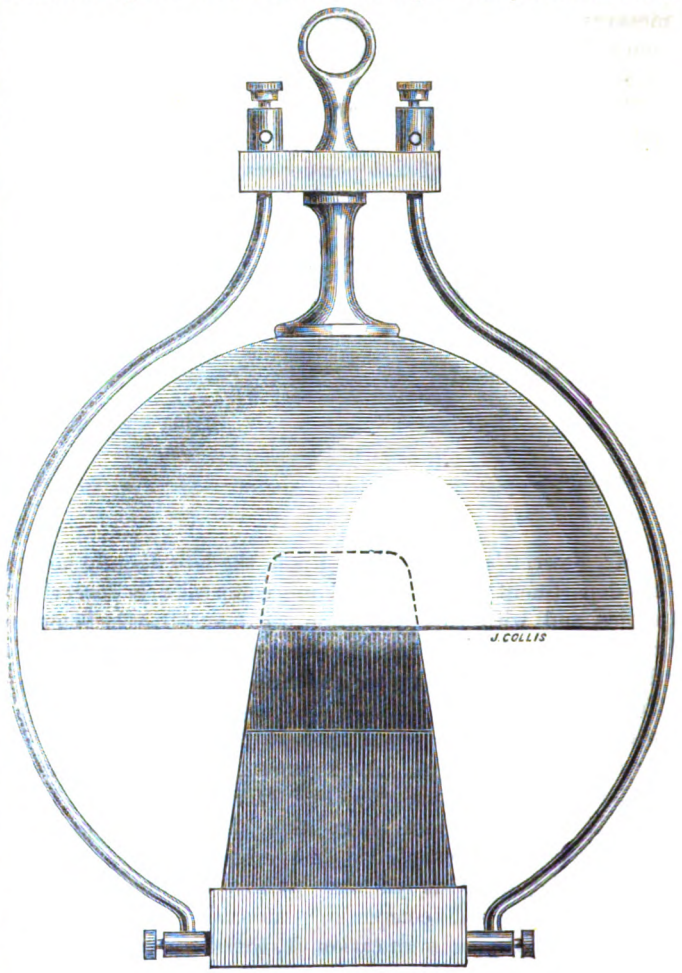
In our notice of the mining lamps in last week's issue we should have completed our description of such lamps by calling attention to one exhibited by Mr. Edison. This lamp is a combination of Mr. Edison's incandescent lamp with a



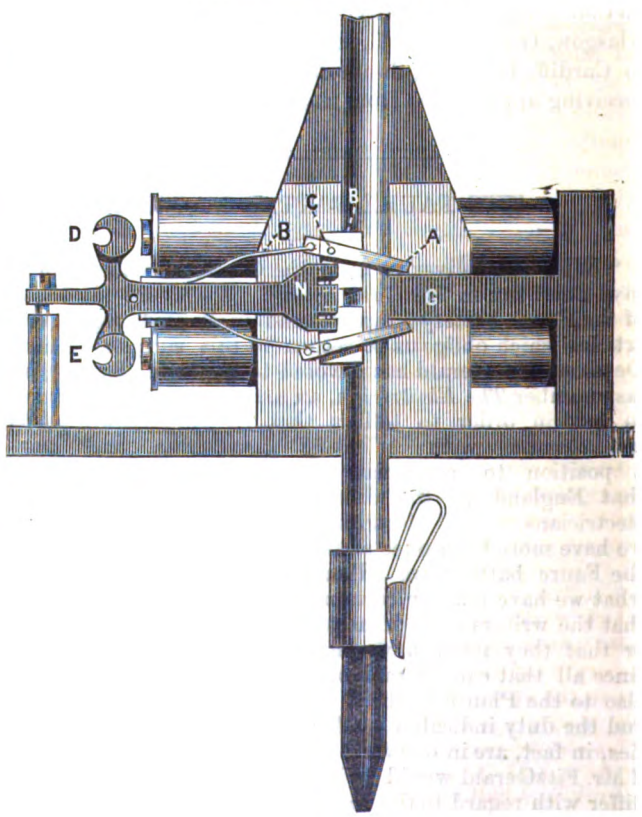


Andrew's Plate Lamp.

portion of a lamp originally designed, we think, by the Hon. R. Brougham and M. André. Mr. Edison, like Mr. Brougham, encloses his lamp wholly within a glass globe partially filled with water, so that the lamp contacts, &c., are under water. We are not aware that this lamp has been practically tried, and although it has obvious advantages it may be found that



Andrew's Plate Lamp.



Andrew's Clutch Lamp.

the disadvantages preponderate. Turning from the lamps of

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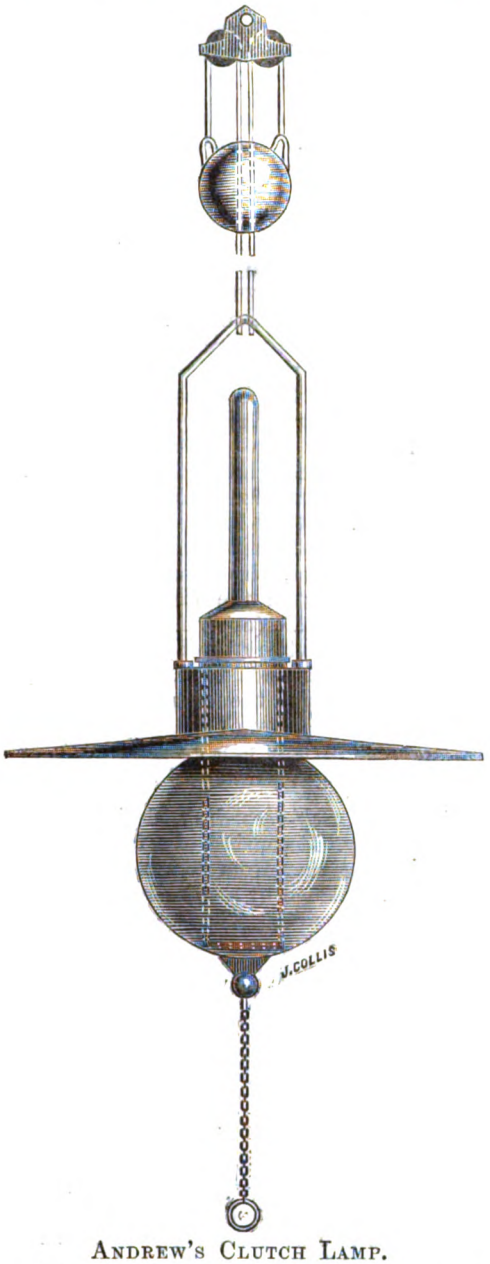
the incandescent class, we notice that Messrs. Latimer Clark, Muirhead, and Co. exhibit some new arc lamps designed by Mr. Andrews, and these will be supplied with a



Andrew's Clutch Lamp.

current obtained from a dynamo-machine designed by Dr Hopkinson. The lamps are herewith illustrated.

Andrews's Plate Lamp.

In this electric lamp the carbons are made in the form of plates, three of which are placed face to face in a stand at a short distance apart, between two conducting holders. The centre one of the three plates is made very thin, and is separated at the bottom by slate from the two outer ones. The outer plates are the electrodes of the lamp, and they are connected to the electrical circuit by two iron springs *(b)*, which press the three plates together at the bottom, and hold them rigidly. The lamp is ignited by an automatic separate lighter, consisting of a small disc of carbon *(c)*, fitted on to the end of a bent lever *(d)*, which is moved to and from the plates by an electro-magnet *(e)* in the base of the lamp. This electro-magnet is of unusual form; it has its core split in two, and in consequence of the repulsion between the halves, one half is made to take the place of the armature of an ordinary electro-magnet; above the coil is an iron strap, to which the armature half of the core is attracted. The action of the lamp is as follows:—The carbon disc *(c)*, when the lamp is out, rests on the plate electrodes, and thus closes the circuit. If the current is now started, the electro-magnet will remove the disc from the plates, producing the arc where it rests The arc quickly rises to the top edges of the plates, where it continues, burning away the three plates at the same rate, and always keeping at the highest point by the repulsion of the current in the plates. By this form of electrode there is sufficient carbon contained in six square inches to last a week, without requiring any attention whatever, producing during this time a steady light of from 300 to 400 candle-power, and any number of these may be placed in one circuit.

Andrews's Electric Clutch Lamp.

The principal feature in this electric lamp is the new form of clutch, which dispenses with the necessity of a dash pot, by firmly gripping the carbon holder rod, and gradually pushing it down as the arc grows longer. The clutch above referred to consists of an iron U strap (*a*) hinged at (*c*) to a block of brass (*b*), which fits the carbon holder rod half-way round. Two separate clutches of this form are arranged on the rod to act in opposition, one to pull the rod up, and the other down. This action is brought about by the attraction of the armatures (*d* and *e*) to their respective magnets. One pole of each only is seen in the figure. The top magnet is wound with fine wire, and is connected as a shunt to the arc. The bottom one is of thick wire, and in the arc circuit.

The action of the lamp is as follows:—Supposing the current is not circulating, then the carbons will be apart, because the spring of the top clutch is stiff enough to prevent the rod from falling, notwithstanding the clutch strap being on the stop (*g*). If the current is now started it will pass through the fine wire magnet, which will attract the upper armature against the force of the spring, and allow the top carbon to fall through upon the bottom one. The circuit thus being closed, the lower magnet will become powerful, and immediately strike the arc by lifting the top clutch off the stop (*g*). As the strength of the lower magnet decreases by the arc lengthening, its armature gradually recedes, lowering the top clutch again on to the stop (*g*), but without releasing the rod. As the fine wire magnet becomes stronger it will attract its armature, and push down the bottom clutch, and with it the carbon holder rod, without interfering with the top clutch, which is pinned only loosely in the slot (*h*). After thus finding the carbon, the armature recedes from the top magnet, raising the bottom clutch to its former position, where it remains until adjustment is again necessary. The above described lamp burns eight hours without removal of carbons. They are already in use on the new docks in Ipswich, and they have been burning some months in the Morecambe Winter Gardens.

Miscellaneous Exhibits.

Among Messrs. Latimer Clark, Muirhead, and Co.'s exhibits are specimens of Howell's Patent Manganese Battery. This battery consists of a stoneware outer jar, A A, inside of which is fixed a perforated stoneware cell, B B, called the "separator," having a number of narrow slots in it in the direction of its length. Inside the "separator" is placed an ordinary porous cell, C C; the porous cell and the "separator" extending to the same height as the outer jar. In the space A′ A′, between the outer jar and the "separator," is placed a rod of carbon, N, fitted in the usual way with a brass terminal for external connections, and surrounding this rod is a mixture of small lumps of graphite and dioxide of manganese, with manganese sulphate, the white manganese of commerce. The whole is sealed up for safety in transport with a compound of bitumen, an aperture being left in the mass for the escape of gases. Inside the porous cells stands a zinc rod, P, kept well amalgamated by means of a little free mercury placed at the bottom of the cell. To charge the battery a solution of sulphuric acid in water (one part acid to four parts water) is poured into the middle compartment B′ B′, formed by the "separator" and the porous cell; and into the porous cell is poured a solution of ammonic sulphate, made by dissolving 25 grammes of the crystallised salt in one litre of water.

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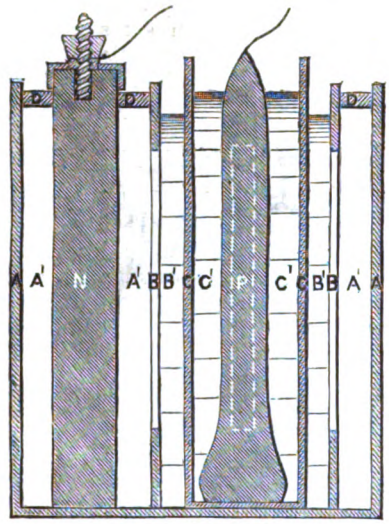
Its electromotive force is stated as = 2·14 volts, with an internal resistance from 5 to 6 ohms. The advantages claimed for this form over other forms of manganese batteries are its greater electromotive force; its lower internal resistance—the mixture of manganese dioxide with manganese sulphate



HOWELL'S MANGANESE BATTERY.

having a higher conducting power than the dioxide alone; and the facility with which the porous cell can be removed for cleaning purposes, without disturbing the manganese mixture in the compartment between the outer stoneware cell and the "separator."

THE UNITED STATES SIGNAL SERVICE exhibit a set of meteorological instruments, consisting of—(1.) *Recorder for Anemometer*, designed by Sergt. A. ECCARD, Signal Corps, U.S. Army. The anemometer proper, with its four hemispherical cups exposed to the free action of the wind, and the self register are connected by wires which run to the battery. One of the wires leading to the anemometer is insulated. No current can pass through the magnet in the recorder until after 50 revolutions of the cups, which are equal to 1-10th of a mile, have been made by the cups, when through a mechanical contrivance within the anemometer, a connection is made. The attracted armature relieves and holds an escapement until the current is broken in the anemometer, when the driving work is set in motion, and the pencil is moved a short distance on the paper on the cylinder, recording 1-10th of a mile of wind. 150 such contacts in the anemometer will cause the pencil to traverse the entire height of the paper. By the particular construction of the screw having a right and left thread the nut carrying the pencils will, on reaching the upper extremity of the sheet, enter the other thread and descend, by which a continuous record is obtained. The two cylinders in the recorder are revolved by clockwork, so that the cylinder to the right gives the daily, and the one to the left the weekly velocity.

(2.) *Anemoscope and Register*, designed by Sergt. A. ECCARD, Signal Corps, U.S. Army. The object of this instrument is to show the wind direction to eight points of the compass. It consists of the vane proper, and a dial having eight points of the compass painted thereon. The hand on the dial always points to the actual direction from which the wind is blowing. The vane has at its base a wire leading to the battery, and eight contact springs which are connected with eight similar contact springs in the driving work behind the dial. The other wire of the battery leads to a clockwork which closes the circuit at regular intervals. The battery wire terminating in the clock passes through a magnet, and from there to the return wire of the eight contact points behind the dial. If the contact is closed in the clockwork, the current passes to the vane, from there through the corresponding contact spring behind the dial, and by the return wire of the latter to the magnet, thence to the clockwork and back to the battery. The armature of the driving work is relieved, and the shaft carrying the pointer is set in motion and revolved until the corresponding cam on the shaft breaks the circuit, when the armature is relieved, the driving work stopped, and the hand left in a position pointing to the proper direction. The clockwork serves the purpose of avoiding the continuous working of the instrument on account of the veering of the vane.

(3.) *Recorder for Anemometer and Anemoscope Recorder*, designed by Lieut. D. J. GIBBON, U.S. Army. This embraces three instruments, the wind vane, anemometer, and recorder. The last consists of a cylinder having a spiral screw on its axis, and a clockwork which turns the cylinder, also five magnets, one for the velocity and four for the direction of the wind. The ruling on the paper corresponds to the spiral of the axis. The three instruments are connected with each other in the following manner:—A wire is run from one pole of the battery to the anemometer, and thence through the velocity magnet to the other pole of the battery; when the current is closed by the anemometer, which is done whenever 500 revolutions are made by the cups, and which 500 revolutions represent the movement of one mile of wind, a current passes through the magnet, its armature carrying a pencil is attracted, and a mark is made on the paper. At the base of the vane are four contact springs which are connected with the four corresponding magnets in the recorder, the common return wire of which leads to a contact within the clockwork. The contact is closed at regular intervals (every five minutes), and the current passes from the battery through the contact spring in the vane, which corresponds to the actual direction of the wind, and thence through the corresponding magnet in the recorder. By the attraction of its armature a metallic point is pressed through carbon paper against the cylinder, and the record made to eight points of the compass.

(4.) *Rain Gauge, Self-recording*, designed by Lieut. D. J. GIBBON, U.S. Army. It consists of a funnel of definite area, and a tube leading therefrom to a receiver. The receiver contains a buoy, attached by a silk cord to the shaft carrying the marking brass spiral. The thread in its passage from the buoy to the shaft passes over a pulley on a lever in such a manner that the buoy counterbalances the lever. As soon as water enters the receiver from the funnel the float is raised, the lever descends, a contact is made and a circuit closed. The attraction of the armature causes the shaft carrying the marking spiral to be revolved by means of a ratchet wheel, the cord is wound up over the pulley on the lever, and the circuit is broken.

(5.) *Barometer, Transmitter, and Recorder*, designed by Sergt. A. ECCARD, Signal Corps, U.S. Army. The object of this barometer is to obtain the atmospheric pressure from points only accessible with difficulty—as, for instance, high mountains, where it is impracticable to keep an observer. By placing the transmitter containing the barometer tube and its appliances on the desired station it is only necessary to connect the same by wires with the recorder, at the nearest convenient place. The practical working of the instrument is as follows:—On the surface of the mercury in the syphon barometer tube rests an iron float, connected with a pivoted lever, to which one of the wires of the battery is connected; said lever maintains a position between two contact points, which are also connected with batteries through the two magnets in the recorder. Any fluctuation in the mercury causes the float to rise or fall, and bring the extremity of the lever into contact with one of the contact points between which it rests. At the moment the contact is made, a current of electricity passes over the line, through the corresponding magnet situated in the recorder; the attraction of the armature relieves the driving work connected with the screw carrying the pencils, which are raised and lowered on the sheet. At the same time a circuit is closed in the driving work, connecting a battery with the magnet in the transmitter. The attraction of the armature of this magnet causes an escapement wheel to be set in motion, by which action the lever is brought back to its original position between the two contact points. These operations take place whenever the

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mercury rises or falls ·002 of an inch. The two cylinders are revolved by clockwork, the one to the right every twenty-four hours, the other to the left every sixteen days.

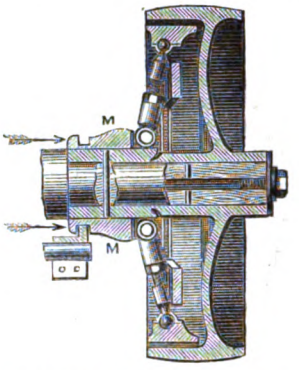
(6.) *One section of a Field Telegraph Train, Signal Service, U.S. Army.* It consists of a battery waggon, wire waggon, and lance truck, fully equipped for erecting lines. The field telegraph trains are organised for use with armies. They are managed by soldiers who are drilled to march with, manœuvre, work, and protect them. The train carries light or field telegraph lines, which can be erected at the rate of three miles per hour, and taken down, repacked, and marched off with the detachment, to be used elsewhere.

(7.) *Lightning-Arrester for Submarine Telegraph Cable* devised by Lieut. J. A. Swift, Signal Corps, U.S. Army. In this arrester three parallel plates are secured perpendicularly to a frame, the two outer (line) plates being fixed, the middle (ground) plate movable. The inner edge of each of the outer plates and the two edges of the middle plate are serrated, and the edges interlocked, so that a certain limited adjustment can be given and controlled by thumb-screws, and the teeth can either be brought into contact or removed to the maximum distance where the spaces are equal between all the teeth. The two outer (line) plates are connected by a fine silk-covered wire of great resistance. The peculiarity of this device is that by adjusting the serrated edges of the middle plate, the atmospheric electricity may pass from the incoming line plate by the shorter path through the ground plate which is connected directly to the earth through one of the armour wires of the cable, or failing so to pass, the silk-covered wire which connects the outer plates will be fused, the connection by that wire interrupted, and the atmospheric electricity will then be forced to pass through the middle plate, in either case guarding the cable from injury. It is only when the wire is fused that the telegraphic communication is interrupted. These arresters have been used since 1878 with highly satisfactory results on the U.S. Coast Telegraph line, which, on account of its numerous cables, is perhaps one of the most difficult lines to keep in working order.

The Rustless and General Iron Company show a variety of specimens of their anti-corrode tubes and fittings. These tubes, &c., have been treated with Barff's process, by which a thin layer of black oxide is obtained. Superheated steam is passed over the iron while it is at a red heat. The process has been known for several years, and has met with a fair amount of success. We should like to have some information as to the chipping of the oxide upon, say, coils of No. 4, 8, or 11 wire, as used for overhead telegraph wires, when moved from place to place, and undergoing the ordinary rough usage of transmission and of handling during construction.

James Stiff and Sons, London Pottery, Lambeth, exhibit porous cylinders of all sizes in red and white ware, and of various degrees of hardness to suit the special requirements of users. Also flat porous plates about 5in. square, and larger sizes up to 12 or 15 inches square. Some of their porous cylinders and plates are glazed on upper edges. They also send flat porous linings, in red and white ware in all variety of sizes. They exhibit vitrified stoneware battery jars, both round and square, in brown and white stoneware. Their stoneware insulators are thoroughly vitrified, and are made in all the usual shapes and sizes. They send models of condensing coils, receivers, retorts, stills, dip arms, acid pans, and all kinds of stoneware chemical apparatus, specially suited for electrical and telegraphic purposes; also plumbago and fire clay crucibles which with their porous and stoneware goods have an established reputation in Great Britain, the continent, and colonies.

Messrs. Volney W. Mason and Co. exhibit their patent friction clutch pulley, such as they have furnished in considerable numbers for driving the Brush machines. We all understand how important it may be that one set of machines should be thrown out of gear and another thrown in without cessation of working, without sudden jerking, &c. The clutch pulley here illustrated is simple. The inner pulley being a split pulley is pressed with greater and greater force against the outer pulley as the gear M is pushed in the direction of the arrows. One of these pulleys, used by the Whittenton



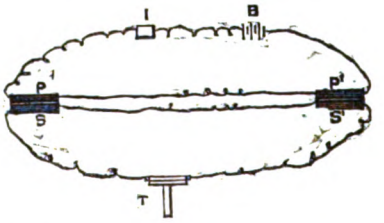
Friction Clutch Pulley.

Manufacturing Company, Taunton, Mass., transmits about 80h.-p., driving six electric machines, starting gradually without slacking the speed of the engine, and by being so connected to the large steam engine has saved expense.

PROBING BY INDUCTION.

Apart from its political importance the illness of President Garfield will in all probability be memorable in the annals of practical surgery by giving rise to the application of the induction balance as a means of divining the locality of leaden bullets or other metal missiles imbedded in the human body. The exalted rank of the patient, and the absolutely painless nature of the searching operation have given the success of Professor Hughes's beautiful instrument a world-wide renown, and some account of the particular arrangement devised by him for the purpose in question will, therefore, not be out of place.

The employment of the balance in this manner appears to have been first suggested by Professor Graham Bell; and the idea originated from the public anxiety felt in America for the wounded President's welfare. On July 16th Professor Bell despatched the following telegram to Mr. W. H. Preece, F.R.S.:—"Can Hughes suggest form of induction balance to locate leaden bullet in President? If so cable at my expense." Mr. Preece immediately communicated with Professor Hughes, who,



after several experiments, telegraphed the same day to Professor Bell instructing him how to modify the induction balance for the purpose intended; and the result was, as we have already recorded, that Professor Bell applied the instrument to the sufferer's body, and determined certain directions of induction, which must all pass through the bullet. The intersection of these lines indicated that the probable location of the intruder is at a point above the right groin about two inches deep.

The particular arrangement of the induction balance employed for the purpose will be understood from the figure, which represents two equal primary coils, PP¹, in circuit with a battery, B, and a rhythmical interrupter or a microphone transmitting the ticks of a small timepiece. The primary current thus disturbed induces a similar secondary current in the secondary coils SS¹, and thus the ticks of the clock or the rhythm of the interrupter are heard in the telephone T. By reversing one of the secondary coils, say S, the induced current in it can be made by proper adjustment to exactly balance the induced current in the other coil S¹, and consequently no sound will be heard in the telephone T. When this balance is disturbed, however, by approaching a fragment of metal near either pair of coils, the noise of the break can be heard more or less loudly

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according to the degree of disturbance. In his apparatus of this form exhibited at the Royal Society Conversazione in May, 1879, Professor Hughes showed how it was possible in this way to detect not only one coin from another, but a genuine coin from a base one, or a just coin from one that had been subjected to a slight amount of attrition. So sensitive was the instrument to the proximity and the molecular quality of metals that Professor Hughes applied it to the analysis of alloys by adapting a scale device to it, whereby degrees of combination could be read off. With this apparatus Professor Chandler Roberts, chemist of the Mint, made a number of very interesting experiments on alloys of different kinds. The balance has not superseded the ordinary chemical mode of quantitative analysis.

To adapt it for bullet-finding all that is necessary is to make one pair of coils very portable, so that they can be moved about in the neighbourhood of the unseen lead until the balance is found to be disturbed. By noting the degree of this disturbance, and exploring in different directions, it becomes possible to point out the spot on the surface of the body beneath which the bullet is believed to lie. A second experiment is then necessary to gain an estimate of the depth below the surface at which it lodges. This consists in moving a bullet similar to that in the wound below the stationary coils until the telephone is silent, for then the disturbance caused by the hidden bullet is exactly balanced by that held in the hand, and, consequently, the distances of both below the opposed coils should be the same. No doubt Professor Hughes will contrive suitable scales for rendering the apparatus as handy and efficient as possible.

The great merit of the invention consists in the fact that all pain is avoided, for the electric influence penetrates the body with impalpable effect; and, moreover, it will be possible to apply it when the ordinary probe could not be used because of the peculiar nature of the wound. Probing is not only painful but uncertain, and when a wound is partially healed it is also dangerous. The new method can be applied in every case, and is unattended by any risk. Curiously enough the same arrangement of the balance was suggested last year in our columns by Mr. J. Munro, C.E., as a means of "prospecting" for gold nuggets and metal veins below, but near, the surface of the earth.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices August 24.		Business Done Week Ending August 24. Highest.	Lowest.
Anglo-American	50⅛,	¼	51⅛	50⅛
Do. Preferred	79½,	80½	82	80
Do. Deferred	23¼,	½	24	23⅛
Brazil Submarine	10⅝,	¾	10⅞	10⅜
Cuba	9½,	10	9½	9⅜
Do. Preference	16½,	17	—	—
Direct Spanish	5,	⅛	5 5-16	5⅛
Do. Preference	14,	15	15	14⅜
Direct United States Cable	10⅛,	⅜	10⅜	10⅛
Eastern Telegraph	10⅛,	⅛	10⅛	10⅜
Do. 6 per Cent. Preference	12⅛,	13½	13⅛	13⅛
Eastern Extension	11,	⅛	11⅛	11
German Union	10⅛,	⅛	—	—
Globe Telegraph and Trust Company.	6½,	⅛	6 9-16	6⅜
Do. Preference	12⅜,	⅜	12⅜	12⅜
Great Northern	13,	½	13⅛	13⅛
Indo-European	28,	29	28⅜	28⅛
Mediterranean Extension	2½,	3	2⅜	2⅛
Do. Preference	9,	⅛	9⅛	9⅛
Reuter's	12,	13	12⅛	12⅛
Submarine	280,	90	—	—
West India and Panama	1¼,	2	—	—
Do. 1st Preference	7,	⅛	—	—
Do. 2nd Preference	6,	¼	—	—
Western Brazilian	7⅛,	⅛	7 15-16	7⅛
West. Union 7 per Cent. 1st Mortgage	125,	130	128½	128½
Do. 6 per Cent. Sterling Bonds	106,	110	107	107

THE LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY (Limited).—River Plate and Brazil Telegraph Company.—NOTICE is hereby given, that the HALF-YEARLY COUPONS which fall due on the 1st September, 1881, of £100,000 Seven per Centum Debentures of the River Plate and Brazil Telegraph Company, will be PAID by Messrs. Glyn, Mills, Currie, and Co., Bankers, at 67, Lombard-street, in the City of London, on and after the 1st day of September, 1881. The Coupons must be left with Messrs. Glyn, Mills, Currie, and Co., for examination, three clear days before the same can be paid.

By order,

WILLIAM PAYTON, Secretary.

No. 66, Old Broad-street, London, E.C., 23rd August, 1881.

ELECTRIC EXHIBITION, PARIS.

TRADE REPORTS, PRICES, and DESCRIPTION of SPECIALITIES, or SALES and PURCHASES ARRANGED at Moderate Commission. Please address,

F. E. FAHRIG, Electrician,
Exposition Internationale d'Electricity,
(British Department.) PARIS.

"ELECTRICIAN."—A COMPLETE SET of "THE ELECTRICIAN," in Volumes or Numbers, is WANTED by B. F. STEVENS, 4, Trafalgar-square, Charing Cross.

TELEPHONE TRAINING SCHOOL, BEULAH-HILL, UPPER NORWOOD.—Under influential patronage.—A complete COURSE of PRACTICAL and SCIENTIFIC INSTRUCTION, with a view to future appointments.—For particulars, address THE PRINCIPAL, Telephone Training School, Beulah Hill, Upper Norwood.

A VILLA RESIDENCE, with good garden and ten rooms, on moderate terms, FOR TENANCY, in South Wimbledon. Apply to Mr. MITCHELL, Dulwich, S.E.

FERD. CAPITAINE, Civil Engineer, 178, BOULEVARD VOLTAIRE, Paris.

Special attention given to every branch of applied electricity. Patents of Inventions applied for and worked on the Continent. Companies formed. Representation at Exhibitions. Commission Agent.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

HARBOROW & CO.,
ELECTRIC LIGHT ENGINEERS
AND
TELEGRAPH INSTRUMENT MANUFACTURERS,
4, CIRCUS STREET, LONDON, W.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.
Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.

NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

THE SCHOOL OF
SUBMARINE TELEGRAPHY & OF TELEPHONY.
ESTABLISHED IN 1868.
4, GEORGE STREET, HANOVER SQUARE, LONDON, W.
MANAGING DIRECTOR: Mr. T. J. JONES, M.S.T.E.

The course of Practical and Theoretical Instruction in the higher branches of Overland and Submarine Telegraphy embraces, in addition to the manipulation of the various systems of working in general use, the following subjects:—

MATHEMATICS, MECHANICS, and CHEMISTRY, In relation to Telegraphy.
SIGNALLING and TESTING INSTRUMENTS.
ENGINEERING FORMULÆ and their Application in Practice.
ELECTRO-STATICS.
ELECTRO-DYNAMICS.
MAGNETISM.
METHODS of TESTING the ELECTRICAL CONDITION of a LINE During and After its Construction.
TESTING FOR and LOCALISING FAULTS, &c., &c., &c.

The instruction, both in signalling and testing, is of a thoroughly practical character, as the classes work with the actual instruments used on long lines, through cables of various lengths, from 600 to 3,000 knots, so that the signals of the Eastern, Atlantic, and Brazilian Co.'s, &c., are exactly reproduced, and the pupils fitted for any line.

A Course of Instruction in the Fitting up, working, and Testing of TELEPHONE CIRCUITS has now been added to, and embodied in, the ordinary curriculum, including all the forms of TELEPHONES, the various switch board arrangements and EXCHANGE SYSTEMS in general use.

Further information can be obtained on application to the SECRETARY.

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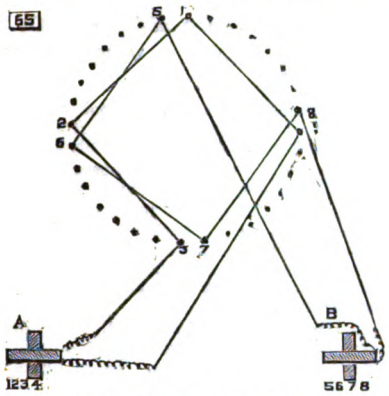
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

65. ELECTRIC LIGHTING, *P. M. Justice.*—*6th January*, 1881.—(*A communication from H. C. Spalding.*) 6*d*.

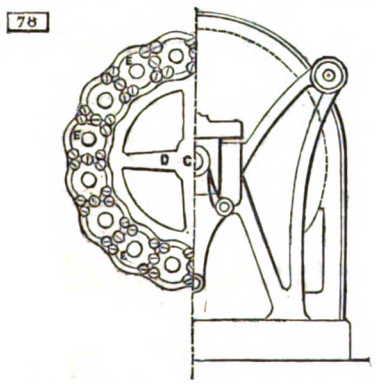
This invention refers to a former patent (No. 3637, 7th September, 1880) for improvements in lighting towns by electricity, and the grouping of the lights. The present patent refers to the subdivisions of each such group. The diagram represents an assemblage of thirty-two lights, arranged in a circle, another arrangement contemplates the use of eight batteries or machines, one to each



sub-group of four lights. For instance, battery A controls sub-group of 1, 2, 3, 4 lights, battery B 5, 6, 7, 8, and so on. Each light of each sub-group is thus separated from its nearest fellow by seven other lights of other sub-groups. The inventor claims that by this arrangement fluctuations in the light of one group exercise no sensible influence on those of another. The number of lights in each sub-group may be varied, but four is, in the inventors's opinion, a good number to have.

78. DYNAMO-ELECTRIC MACHINES FOR ELECTRIC LIGHTING, *J. E. H. Gordon.*—*6th January*, 1881. 6*d*.

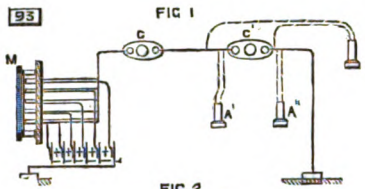
The inventor's machine is designed to maintain a large number of independent lights, and to work equally well, if the number of lights in operation be increased or diminished whilst it is in operation. It consists of a number of discs mounted on an axis, carrying at their peripheries cylindrical bobbins of insulated wire arranged with their axes parallel to the axis of the machine and equidistant from it. They are wound on an iron core, and are converted into electro-magnets by permanent connection with a

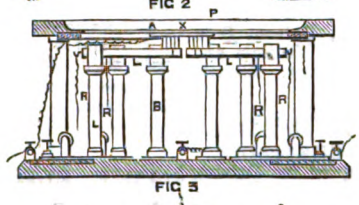


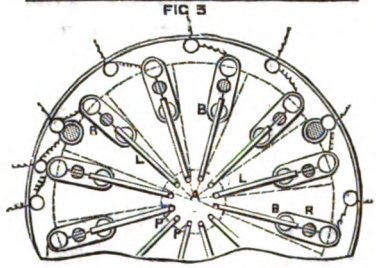
direct current-exciting machine; the coils may be combined in series or quantity as required. Between the discs other bobbins are arranged, carried by stationary brackets; they also have cores of a bundle of iron wires or a slit tube. The bobbin is divided by a number of insulating discs, like the secondary of a Rhumkorf induction coil. A tube of ebonite is placed between the core and the conducting wire. These insulating discs are usually made of card. The induction bobbins are arranged so that the ends of the cores of the moving electro-magnets pass very close to their ends. From each of these stationary bobbins a separate circuit may be led away to supply a lamp or lamps, or two or more bobbins may be connected in series or quantity for the same purpose. The figure shows an end elevation of the machine. C is the main shaft of steel, D is a brass wheel with cylindrical cavities for the electro-magnets, E E are electro-magnets.

93. TELEPHONIC APPARATUS, *J. Imray.*—*8th January*, 1881.—(*A communication from Dr. C. Herz.*) 6*d*.

The object of this invention is to obtain clear articulation and freedom from the effects of earth currents. To accomplish this, the receiver is made microphonic by the use of discs of conducting ores, each of the discs being separately connected to pairs of voltaic elements, all being pressed together with adjustable pressure, and subjected to the sound vibrations of a diaphragm. The sounds are thus magnified, and to render them distinct, condensers are introduced in the line. To avoid earth currents the line wire, instead of going straight to earth from the receiver, is terminated in a number of fine points extended over a large area, and another set of such points close to the former set communicate by a wire to earth. One method of arranging the instruments is shown in Fig. 1. M is a microphonic transmitter, one convenient form of which







is shown in section, Fig. 2, and in plan with front cover removed, Fig. 3. On the vibrating diaphragm X are fixed a number of plates P of iron pyrites. Against each of these is pressed a piece of carbon, A, on a lever, L, the pressure of which is regulated by spring R. Each alternate contact piece is connected to the positive pole of a battery cell, the other alternate contact pieces being connected to one terminal plate of a large surface condenser, C, the other terminal plate of which is in connection with the line wire. The negative poles of the battery are connected to earth. At the receiving station a bell telephone may be employed alone, but it is better to use a second condenser, C^1, having one of its terminal plates connected to line and the other to earth. The receiving telephone may then be placed in either side of the condenser as indicated at A^1 or A^{11}. Various other arrangements are shown, including the arrangement of the diffuser for the prevention of earth currents.

5008. IMPROVEMENTS IN ELECTRO-MAGNETIC INDUCTION MACHINES, *H. Wilde.*—*1st December*, 1880.—(*Void.*) 2*d*.

This invention consists of a method of constructing electro-magnetic induction machines with multiple armatures, by which their efficiency would be greatly increased.

5211. LIGHTING MINES, *P. Adie.*—*13th December*, 1880.—(*Provisional protection not allowed*). 2*d*.

This consists in an electric light burning in a vacuum, the wires being so supported by the lamp that if the lamp were broken the electric current would at once be broken and the light extinguished.

108. CONVERTING HEAT INTO ELECTRICITY, *J. C. Ramsden.*—*8th January*, 1881.—(*Not proceeded with.*) 2*d*.

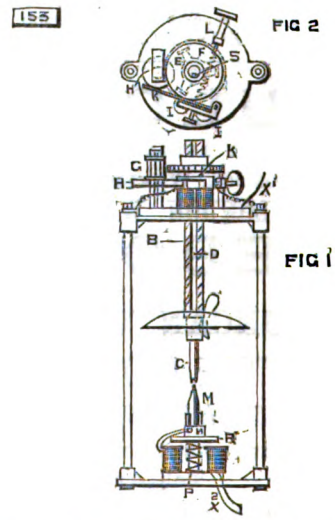
The object of the invention is carried out by placing spliced iron rods in a furnace, the external portion of the rods being enclosed by a porcelain cylinder. To the outer end of the rods are attached metal conducting bars, to which bars are attached wires, each pair of wires being continued and the circuit closed in the ordinary way. The furnace has each end contracted, and at the mouth of each is arranged two tubes with fine orifices, one being in communication with refined petroleum, and the other with a supply of steam. When steam is discharged over the mouth of the petroleum tube it exhausts and discharges the hydrocarbon in the form of spray. On being fired an intense heat is generated, and being free from impurities no deposit on the bars takes place.

152. ELECTRIC BATTERIES, *J. A. Lund.*—*12th January*, 1881.—(*Not proceeded with*). 2*d*.

The inventor forms a battery of a cell containing sulphuric acid, with zinc lying in mercury at the bottom of the cell for the one element, whilst for the other he uses plates formed of a mixture of manganese and carbon.

153. ELECTRIC LAMPS, *A. Muirhead and J. Hopkinson.*—*12th January*, 1881. 6*d*.

This invention refers to improvements in the construction of arc lamps, and also to the preparation of the carbons for incandescent lamps. In Fig. 1 a rod carries upper carbon C, and has cut on it a screw, B B, and groove, D D, the screw working in the fixed nut E E and the socket of wheel F (see also Fig. 2). The socket contains a key S working in the groove D D. F is geared into a lantern pinion, G, on same axis as the brake wheel H, the revolution of which, caused by descent of the rod, is controlled by the armature K of electro-magnet I. The coils of this latter are connected to the terminals and to the insulated rod leading to lower carbon, and thus a shunt to the arc is formed. Armature K is kept bearing against H by means of adjustable spring



L, the tension of which is overcome by the current in I, and the wheel permitted to revolve whenever the arc is too long. The action is as follows:—Suppose the carbons to be in contact; in passing a current through lamp circuit from X^1 to X^2, magnet O O will draw down R R, together with lower carbon M, upper carbon C being prevented from following by the brake, an arc will be thus formed. As the carbons burn the resistance of the arc becomes greater and the current in I I greater, until the magnet is strong enough to overcome the tension at L, when H is liberated and the carbon approaches to the proper distance. When great continuity of feed is required a fluid brake is attached to the brake wheel. The latter part of the specification refers to the method of preparing carbon filaments of silk, hornbeam, &c., for incandescent lamps, and the manner of securing same in the lamp.

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ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians,
86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.
pecialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manu-facturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works,
IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited),
HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers,
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Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia
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Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER
WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

VULCANITE.
HARBURG INDIA-RUBBER COMB COMPANY.
LONDON WAREHOUSE: F. WINTER.
138, LONDON WALL, WOOD ST., E.C.
EBONITE.

DUNCAN WALLET & CO.,
BONDED STORE AND PROVISION MERCHANTS,
15, BILLITER STREET, LONDON.

Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

JOHNSON'S TRANSMITTER
(PATENT).

LOUD AND CLEAR. NO JARRING.
PERMANENT ADJUSTMENT.
NO OXIDATION. ONE LOCAL CELL.

TASKER, SONS & CO.,
ELECTRIC AND TELEPHONIC ENGINEERS,
SHEFFIELD.

ELECTRIC LIGHT.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

ELECTRIC LIGHT.

THE ELECTRIC LIGHT and POWER GENERATOR COMPANY (Limited) are prepared to take orders for either the

INCANDESCENT LIGHT,

30 to 60 candle power (burning in vacuo), for domestic purposes, or the

ARC LIGHT

for Halls, Railway Stations, Streets, &c., &c.

Particulars, Price Lists, &c., by application to
The SECRETARY, 29, BANKSIDE, SOUTHWARK.

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

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FRANCIS RAVENSCROFT, Manager.

Southampton-buildings, Chancery-lane

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Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

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Gilt and Silver Cord for Hanging Pictures. Iron, Steel, and Copper Cord for Clock and Sash Lines, &c.

R. S. NEWALL & CO., LONDON, 130, STRAND, W.C.

LIVERPOOL—36, Waterloo Road. GLASGOW—68, Anderston Quay. Manufactory—GATESHEAD-ON-TYNE.

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SLIP

West Indies.—The cable between St. Vincent and Barbadoes is now repaired.

Cable Interrupted.—A Reuter's telegram, dated New York the 29th of August, says the telegraph line to Cuba is interrupted.

The Faure Battery.—M. Faure is making experiments in lighting the fish tanks at the Aquarium with Maxim lamps fed by his battery.

Electric Light at Seacombe.—It is reported that the Wallasey Local Board are thinking of lighting Seacombe Ferry by the electric light.

New American Company.—The incorporation of the Long District Electric Call Company, with a capital stock of 50,000 dollars, is announced.

The Telephone in Sheffield.—There are now 150 subscribers to the Sheffield Telephone Exchange. The number of calls last week exceeded 7,000.

Telephones in Switzerland.—The Government are establishing telephonic communication in Berne. The wires are carried over head on posts fixed to the housetops.

Electric Light at Eastbourne.—The lighting of Devonshire Park, Eastbourne, by Siemens lamps has proved so successful that we believe the system is to be extended to the Parade.

Electric Lighting of Trains.—News from New York says that the Lehigh Valley Railroad Company is preparing to experiment with electricity, as a substitute for gas, in lighting the cars on all through trains.

Exhibitors at the Paris Exhibition.—According to the official catalogue there are 544 French exhibitors, and 944 exhibits, and 525 foreign exhibitors, with 837 exhibits or, altogether, 1,069 exhibitors and 1,781 exhibits.

Obituary Notice.—M. Jean Takas, Director-General of Telegraphs in Hungary, died on the 6th of July last in his 68th year. He had been in office since 1867. He took part in the Telegraphic Conference held in Vienna in 1868.

Reducton of Tariff.—The West India and Panama Telegraph Company has notified a reduction in its tariff between the West Indies and Europe. In future 3·61 dollars will be charged instead of the present rate of 3·86 dollars.

Electric Light at Liverpool.—It is stated that the British Electric Light Company have obtained the contract for lighting the premises of the North Shore Flour and Rice Mills Company in Boundary-street, Liverpool, with incandescent lamps.

The Consumption of Carbons.—Letters from MM. Jablochkoff and Gravier have appeared in recent numbers of *La Lumière Electrique*, insisting on the importance of noting the weight of the carbons consumed in electric lamps, in place of their length.

Electric Light in Reunion.—In order to push on the works of constructing a new harbour and docks in the little island of Reunion, the only French possession in the Indian Ocean, the electric light has been used at night, and the work carried on night and day.

Optical Telegraphy.—"Télélogue" is the latest word coined for an optical telegraph apparatus about to be introduced into the French army, and somewhat similar to the English heliograph. Electrical science is now under a heavy obligation to the Greek language.

Prices.—The prices as quoted are, for gutta percha per lb.: —Genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d.; for India rubber: Fine Para, 3s. 5d.; negrohead, 2s.; central American, 1s. 6d. to 2s. 3d.; Assam and Pegu, 9d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 4d. to 2s. 2d.

Electric Light at Tours.—During the recent *fêtes* in honour of M. Gambetta, at Tours, which took place in July last, Messrs. Siemens lighted the exhibition that was held there with ninety of their lamps. The jury were so pleased with them that they have presented Messrs. Siemens with a "*grand diplôme d'honneur.*"

Organisation Against Patent Infringements.—It is stated that the principal electric lighting companies, comprising the Brush, the United States, the Fuller, the American, the Jablochkoff, and the Western, have united in an organisation to enforce their numerous and important patents against manufacturers and users of infringing patents.

Telegraph Posts Wanted.—The Great Indian and Peninsula Railway Company are inviting tenders for the supply of telegraph posts. Specifications and forms of tender can be had at the company's offices, No. 3, New Broad-street, E.C., where tenders must be sent, addressed to Mr. Thomas B. Watt, managing director, by 12 noon on the 9th of September.

Accidents by Lightning.—A daily contemporary, speaking of the storm of last week, says:—"The storm which has swept over Devonshire has had extraordinary results. At Thorverton the granite uprights of the old stone bridge were cut through, the lightning having struck the iron rail. The postmaster heard a report as of a gun, and found his telegraph instrument smashed."

Radiophony.—Professor Mugna, repeating M. Mercadier's experiments, in which an intermittent beam meets a smoked surface within a glass tube, containing aqueous or ammoniacal vapour, and furnished with an ear tube, adds to the effects by attaching a small microphone to an elastic membrane closing the tube. By this means he finds it possible to operate at a sufficient distance from the interrupting disc to render its noise no longer disturbing.

Paris Time for Marseilles.—Marseilles is to have an electric clock, which will be regulated daily from the Observatory at Paris. France is not so well placed as we are in this matter, there being but very few towns at present that have clocks regulated from Paris, in the same way that noon time is sent from Greenwich in England. The Minister of Public Instruction has, we notice, issued a circular offering to establish electric clocks in all seaport towns in France.

Incandescent Lamps on Board Ship.—The steamer "Arabic," which is the latest addition to the White Star Company's fleet of American liners, has been fitted with Swan incandescent lamps. It appears that she will only run temporarily to New York, being intended for service in the East Indies. For the hot climate she will meet with in the latter, the benefit of the Swan lamps in not heating the air of the saloons, &c., will be much appreciated by passengers.

An Electric Steering Apparatus.—Referring to the electric steering apparatus of Mr. King, of Edinburgh, which has lately been tried on a steamer between London and Glasgow, in which the compass regulates the helm, *La Lumière*

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Electrique remarks that so far back as 1859 M. Achard designed an apparatus, founded on the same principle as his brake, which allowed the rudder to be electrically controlled from the captain's cabin, but that the compass played no part in this device.

A Modification of the Plante Battery.—With reference to our note of last week on the modifications introduced by M. de Pezzer in the Planté secondary battery, M. Ducretet writes that he has obtained good results by using electrodes made of sheets of lead, having their surfaces covered with deep indentations produced by a roller with indented surface. M. Ducretet says that these batteries form more quickly, have more energy, and are not so heavy as the ordinary ones.

Telephonic Music.—The subscribers to the Bell Telephone Exchange at Charleroi, in Belgium, were informed the other day that a telephonic concert would take place on the 14th of August at the central office, and that communication would be established at 11 a.m. precisely, when they were requested to apply their telephones to their ears without calling the central station. The concert took place at the hour indicated, and those subscribers who listened had the pleasure of hearing the following pieces played, viz., an overture, a walse, a polka, and the Belgian National Anthem, the Brabançonne.

Electrical Tramway in Paris.—News from Paris says that Messrs. Siemens's electrical tramway has begun to work, and has several times gone backwards and forwards. A single overhead tube was tried at first to convey the current, but it was found impossible to insulate the rail by which it returned. Two overhead copper tubes are now used, along each of which at the bottom runs a longitudinal slit. A wire passing through the slit is attached to the tramcar beneath, and above to a small wheel which runs freely in the copper tube. As the car advances it draws along the little wheels through each tube, and thus maintains the connection.

Technical Education Abroad.—The *Gazette* of Friday, the 26th of August, contains Her Majesty's commission "authorising and appointing Bernhard Samuelson, Fellow of the Royal Society; Henry Enfield Roscoe, Doctor of Civil Law, Fellow of the Royal Society; Philip Magnus, Bachelor of Arts and Bachelor of Science; John Slagg, Swire Smith, and William Woodall, to inquire into the instruction of the industrial classes of certain foreign countries, in technical and other subjects, for the purpose of comparison with that of the corresponding classes in this country; and into the influence of such instruction on manufacturing and other industries at home and abroad."

Private Telegraph Rents in Vienna.—The following are the conditions of subscription to the Wiener Privat Telegraphen Gesellschaft, or Vienna Private Telegraph Company, viz.:—For connection with the central office, the yearly rental is fixed at 100 florins for a distance of ten kilometres from the central office, and for each kilometre beyond an additional 25 florins. The central office is open during the summer from 7 a.m. to 9 a.m., and in winter from 8 a.m. to 9 p.m. For direct communication between offices, banks, and the private houses of any person, by telephone, the company charge 160 florins per annum for a distance of two kilometres, and 40 florins for every additional kilometre.

Telegraphic Communication with Iceland.—With reference to our note of last week under this heading, the *Standard's* correspondent at Copenhagen says:—"With reference to the proposed telegraph cable to Iceland I have had an interview with M. Madsen, the telegraph engineer who laid most of the submarine Chinese and Japanese cables, and who is now the consulting engineer and superintendent of the Great Northern Telegraph Company. M. Madsen assures me that all the calculations and plans for laying the cable are ready, and work can be at once begun. The cable is to start from some point in the north of Scotland, probably from the place called Thurso. The cost will amount to about two hundred and fifty thousand pounds."

Struck by Lightning.—An inquest was held a few days ago on the body of a man who had been killed by lightning. During a heavy thunderstorm deceased took shelter under an elm tree by the side of the road. The tree was struck by lightning, and the evidence of the doctor went to show that the electric current passing down the trunk struck deceased on the right temple, inflicting a wound two inches long, singeing the whiskers, and scorching the right side of the face and neck. The current then passed obliquely across the chest to the left side, cleanly cut open the trouser seam, ripped up the back of the coat, and escaped into the road, which was torn up to a depth of several inches. Deceased's watch was forced from his pocket, and was found in the lining of the waistcoat at the back, the case being melted.

Interruption of Telegraph Communication with Shanghai.—The Great Northern Telegraph Company say that it is fully expected that the interruption of he Company's lines which has been caused by a typhoon raging in the North of China during the last few days, and which isolates Shanghai both North and South, will be restored almost immediately, as the breaks are close to the shore, and as the Company's repairing steamer is on the spot. Meanwhile, should communication not have been restored, messages will be forwarded by a steamer from Nagasaki to Shanghai, which is expected to leave Nagasaki early this day (Saturday). Steamers from Nagasaki take, as a rule, forty-four to forty-eight hours to reach Shanghai. Steamers from Hong Kong to Shanghai cannot reach the latter place in less than four days.

The Telephone and Railway Companies.—The use of the telephone has been adopted on the system of the London, Chatham, and Dover Railway Company, and during the past few days the office of the superintendent, Mr. Cockburn, at Victoria, has been placed in immediate communication with Holborn Viaduct, the City terminal station; with Loughborough Junction, where there are large sorting and make-up sidings; and with Wandsworth-road, where are the headquarters of the locomotive and other departments. The goods manager's office at Victoria has also been connected with the goods *depôt* at Blackfriars. The instruments in use are constructed on the Gower-Bell principle, which for some time has been used satisfactorily to connect the Victoria Station with the residence of the chairman, Mr. J. S. Forbes, at West Wickham, near Beckenham.

Telephone Wires as Lightning Conductors.—With reference to our recent extracts from two Continental contemporaries on this subject we quote the following from the *Operator*:—"It is a fact that where there are a sufficient number of wires crossing any roof they form practically a much more reliable safeguard against destruction from lightning discharges than do fifty per cent. of the lightning rods, since they must, in order to perform their legitimate functions satisfactorily, form a good connection with the ground in at least one of their terminals. Even when but a few wires cross a roof they protect that roof to a considerable extent. That property is protected by the wires passing over it needs no other proof than the fact that the lower part of New

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York, which is literally covered by a network of wires, has for many years possessed almost perfect immunity from lightning casualties."

THE FUTURE OF RADIOPHONY.—In an article on the researches of Messrs. Bell, Tainter, Preece, Tyndall, Mercadier, &c., on this subject, our contemporary the *Journal Télégraphique* says:—"Will it not be possible to utilise this discovery for telegraphic purposes. At first sight the thing does not seem impossible, and it was this possibility which led M. Mercadier to make the researches he has. At the same time we must bear in mind that the times are not favourable to this discovery. On the one hand we have the telephone, which solves in the simplest way and without the aid of a luminous source, the problem of transmitting speech to a distance; and on the other hand, the only body with which we have been able to reproduce articulate sounds by means of rays of light is subject, as regards its electric conductivity and molecular state, to fluctuations which would render it very difficult of employment for regular communications."

A STORM IN THE TROPICS.—The *Sydney Morning Herald* of the 1st of July says:—"The German war schooner Nautilus, from Tahiti, reports having experienced a very tempestuous voyage. During the passage the vessel fell in with an extraordinary atmospheric disturbance. On May 11 the whole heavens, in the afternoon of that day, appeared enveloped in black, inky clouds, making it so dark that it was difficult to see the length of the ship. The thunder became almost deafening, and the lightning nearly blinding. Those on board expected each moment to be struck by a bolt, as the lightning was striking the water all round the vessel, which made a grand and most singular sight. The continuous streaks of fork lightning gave the vessel the appearance of being in flames in a dozen different places at once. In several instances bolts struck the water within a radius of twenty to forty yards of the vessel. During the storm very little rain fell, and the sea was almost calm."

TELEGRAPHIC COAST SIGNAL STATIONS.—In the House of Commons last week, Mr. Fawcett, answering Mr. G. Howard, said:—"In reply to my hon. friend, I beg to say that the Committee of Lloyd's have applied to the Post Office with the object of ascertaining what would be the cost of extending the telegraph to five signal stations at various parts of the coast. I have just communicated to Lloyd's the terms on which the proposed extensions could be carried out. Should these terms be accepted, the extensions might be commenced at once, and on the opening of the stations the Committee of Lloyd's would be able to make their own arrangements as to the amount to be charged to vessels for signalling their messages, and the department would transmit any message from these stations to Lloyd's at the press rate of one shilling for seventy-five words in the day and one hundred at night." With reference to the above we believe that the Telegraph Construction and Maintenance Company have already in hand several short cables for connecting certain lighthouses with the shore.

BATTERY CARBONS.—Signor Mauri (*Revista Scientifico Industriale*, No. 11) obtains an economical and very compact battery carbon, intimately united with the electrode, as follows:—Finely powdered graphite is mixed with an equal weight of sulphur (which should be free from carbonates), and the mixture is heated in an iron vessel until complete fusion of the sulphur. The temperature should not be raised beyond 200 degrees. When the mass is fluid it is poured into a suitable metallic mould, and a thick copper wire, bent zigzag, is quickly inserted, a part being left projecting. The mass is let cool slowly; then it is easily drawn from the mould and is ready for use. These carbons have a conductivity practically equal to that of retort carbon, and are more electro-negative, consequently better adapted for electromotive force. Coke-powder cannot be substituted for graphite, because it has too little conducting power. By increasing the proportion of sulphur, the resistance may be increased at will, and strong resistances may be thus easily prepared in place of resistance coils of copper wire.—*Nature.*

THE BICHROMATE BATTERY.—The *Zeitschrift für Angewandhe Electricitäts Lehre* makes some remarks on an arrangement of the bichromate battery, which is very simple, and permits of the zinc being easily replaced when exhausted. A great deal of zinc and exciting liquid is very soon consumed in the ordinary battery, for the following reason:—The zinc is attacked by the mixture of sulphuric and chromic acid, hydrogen is given off, and this gas reducing the chromic acid to oxide of chrome, causes the formation of chrome alum and potash. As this salt has a greater density than the chemical solution, it falls to the bottom of the jar with the sulphate of zinc. Now, if the zinc were placed at the bottom of the jar, it would be protected before long from the direct action of the chromic acid. Batteries constructed on this principle appear to have given good results. If the surface of the carbon is large enough, they are more powerful than the Leclanché batteries and cheaper. We would add that the solution of bichromate acid should not be too strong, or the chrome alum and potash might be deposited in the shape of crystals on the zinc.

EARNOCK COLLIERY.—We have refrained from giving the details of the lighting of this colliery because there seems to be a little soreness and misunderstanding at Glasgow as to the parties to whom credit should be given. We cannot describe the work without mentioning names, and as we are utterly unable to decide upon the real facts from the reports which have been sent from several friends we have simply recorded the introduction of the electric light at this colliery. We would suggest that, in the interests of science, wrangling as to what this or that person has done is to be avoided as far as possible. If, instead of carrying out an idea, any party had originated an idea, then the person who took the initiative would have just grounds for his claims to be considered. Given a colliery proprietor willing to spend the money, and a few score of electricians will be ready to adopt and modify the existing apparatus to meet the requirements of the case. This is what has been done at the Earnock Colliery. The lamp used is a modification of Swan's, the machines are the usual machines, and so on. We believe that Professor Abel has visited the mine and seen the lamps in action.

TELEPHONE COMPANIES AND THE STATE IN BELGIUM.—The Belgian Government have lately published the terms in which they will allow the installation of telephonic exchanges, and these terms have roused the ire of our contemporary *La Chronique des Trauvaux Publics*. Amongst the terms we find these:—That concessions shall be publicly tendered for at a discount based on the maximum price of the subscriptions; that a reduction of 33 per cent. be made for State messages, and that 10 per cent. of the whole receipts be paid to the Government; that the Government may after the sixth year take possession of the telephone lines, for which it will pay an annual indemnity during the remainder of the term of the concession calculated on the net revenue of the three preceding years. "That is," remarks our contemporary, "when all costs have been defrayed, the installa-

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tion established, the service assured, and the *clientèle* obtained, the State will step in and take the benefit. . . . At present telephone companies are searching after the best *modus vivendi* when all other countries have welcomed with enthusiasm this wonderful invention." It appears that the Government some time since compelled the three telephone companies—the Bede, Gower, and Bell—to amalgamate.

Comets' Tails.—At the meeting of the French Physical Society, on the 16th of August, M. Jamin stated his opinion that the luminosity of comets' tails must be due to combustion or electricity. Now, the experiments of Crooke have shown that the spectrum of the electric arc produced in vacuo or in highly rarefied air does not give brilliant rays. This was exactly the case of the last comet. M. Jamin, therefore, rejected the hypothesis of combustion, which would have evidently produced a spectrum traversed by brilliant rays, and inclined to an electrical illumination of the nucleus which projected into space a long luminous train. At the meeting on the 22nd of August, M. Faye stated as his belief that electricity at very high tension was given off at the surface of the sun, and that this electricity acted on the matter of the comet, and repelled it to a distance, or he thought it possible that the excessive heat at the surface of the sun might be the cause of this repulsion. He brought as evidence an experiment that he had made. He caused the discharge from a Rhumkorff coil to traverse a receiver containing rarefied gas. The gas became brilliantly illuminated. About the centre of the receiver he also placed a platinum plate which could be raised to incandescence by an electric current. When incandescence took place the electric arc stood out from the plate, and from this he concluded that incandescent bodies were possessed of a repulsive force by reason of their high temperature. This experiment did not appear to be conclusive to M. Becquerel, who disagreed with the explanation of M. Faye.

The Microphone in Observatories. — The idea of utilising the microphone in observatories, which occurred to M. Van Rysselberghe, of the Royal Observatory, Brussels, in May, 1880, has been adopted in the Observatory at Geneva. By its aid, in combination with the telephone, the sound of the beats of the normal pendulum have been made audible in every part of the building. M. W. Meyer, assistant-astronomer at the Geneva Observatory, has given some details of the installation in the *Archives des Sciences Physiques et Nationales*, which we reproduce. The microphone is fixed to the exterior of the framework in which the pendulum swings. One of the conducting wires connects one pole of an ordinary sized Meidenger cell with the microphone, whilst a second wire goes from the other pole of the battery through a telephone and commutator with three binding screws, to the microphone. The two wires coming from the coil of the telephone are very fine, and are interlaced so as to form one supple cable. By this means the telephone can be carried into any part of the Observatory, wherever required. Thus, it can be carried up to the top of the building and the course of the stars watched, whilst listening to the number of beats of the pendulum. By means of a second telephone, with one wire fixed to the third binding screw of the commutator, the pendulum beats can be heard equally well in the lower rooms of the Observatory, as in the upper portion. The Observatory is also connected with the Hôtel Municipal, so that the beats of the electric clock regulator in that building can be heard in the Observatory and compared with the beats of the pendulum in the Observatory. At a certain hour the person whose duty it is to regulate the regulator in the Hotel Municipal gives notice to the Observatory, by ringing a bell, that he is at his post. He then connects his telephone line, and the astronomer tells him how far the regulator is wrong; he puts it right, and re-establishes the microphonic communication in order that the astronomer may test the regulator again by the pendulum. All this is done in about five or seven minutes. The apparatus is stated to have always worked well.

Molecular Magnetism.—The following remarks on this subject by Prof. Wiedemann appear in the September number of the *Phil. Mag.*:—"In the *Proceedings of the Royal Society of London*, vol. xxxi., p. 532, vol. xxxii., pp. 25, 213 (1881), Prof. Hughes has published a series of papers on the relations between magnetism and torsion, upon which I beg leave to make the following remarks:—In his first paper, Prof. Hughes has quoted from my work on Galvanism and Electromagnetism (1st ed., vol. ii., p. 438, instead of p. 447 as cited) an experiment of mine, by which I had shown that an iron wire through which a current flows is magnetised by torsion. He says that Sir William Thomson had attributed this magnetisation to a spiral arrangement of the current in the twisted wire. Now, in the passage above referred to, I state distinctly that, if an iron wire is twisted during or *after* the passage of a current, it becomes magnetic. In the latter case there is no longer any current in the wire. I have observed this magnetisation directly by the deflection of a magnetic mirror, and determined its direction. In accordance with many other observations I have fully treated the rotations of the magnetic molecules upon which this magnetism depends, and illustrated it by a woodcut. ('Galvanismus,' 1st ed., ii., p. 453; 2nd ed., iii. (1) p. 573.) Still more fully are these phenomena and others related to them treated in the volumes of *Poggendorff's Annalen*, from 1858 to 1862, quoted in my work. (*Pogg. Ann.* ciii., p. 563 (1858); cvi., p. 161 (1859); cxvii., p. 203 (1862); and *Monatsber. d. Berlin. Acad.*, 1860, 29 Nov.; also in the *Annales de Chimie et de Physique*, the *Archives de Genève*, *Silliman's Journal*, &c.) In the year 1866 (*Pogg. Ann.* cxxix., p. 616.) I showed that when a current is directed through an iron wire extended in the axis of an induction-coil and the wire is twisted or untwisted, induced currents are produced in the coil; further, that similar induction currents are produced by twisting or untwisting the wire after having interrupted the current passing through it; also that analogous induction currents pass through the wire itself when, after the passage of the current, its ends are joined to a galvanometer and it is twisted or untwisted. These results in each case follow directly from my former direct observations on the magnetisation of an iron wire by twisting or untwisting during or after the passage of a current. It is not difficult to vary the experiments, as, in fact, Professor Hughes has done. My purpose being to establish the principles of these phenomena, I considered it best to study them under the simplest possible conditions. It gives me great pleasure to find that the experiments of so distinguished a philosopher as Professor Hughes, which either agree completely with my own or have been made with some variations of method, confirm the results which I obtained about twenty years ago, and that, in describing molecular magnetism as a singular form of magnetism, he has independently come to the same conclusions as those published by me in the years 1858-1862, when enunciating the theory of the relations between magnetism and mechanical changes of magnetic bodies." The papers by Prof. Hughes referred to by Prof. Wiedemann were given in *The Electrician*, Vol. VI., Nos. 19 and 21, and Vol. VII. Nos. 2 and 3.

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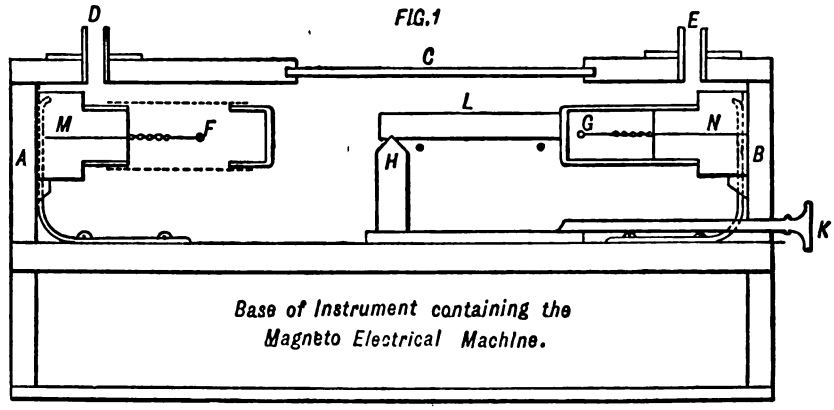
THE ELECTRICAL EXHIBITION AT PARIS.

In our description of Howell's battery the internal resistance should have been between ·9 and 1·1 ohm, and not from 5 to 6, as stated.—Vide *Electrician*, No. 15, Vol. VII., p. 236.

Miscellaneous Exhibits.

Messrs. Latimer Clark, Muirhead, and Co. show an instrument for the detection and measurement of inflammable gas in the atmosphere of mines, designed by Mr. E. H. T. Liveing. The instruments that have hitherto been suggested for the detection of fire damps may be classified under two heads—first, those which depend for their action upon the *physical* properties of the gaseous mixture; and, secondly, those dependent on its *chemical* or combustible properties. Under the former head we have the instruments of Mr. Ansell and Professor Forbes, the one dependent on the diffusion of gases, and the other on the velocity of sound; while under the latter head we have the ordinary flame test, the instrument, or rather apparatus, of M. Coquillion, the spark tube of Dr. Angus Smith, and, lastly, that of Mr. Liveing. Strong arguments can be urged to show the superiority of the latter class of tests over those of the former type; *for it is the heating value of the gaseous mixture, or its approach towards the explosive proportion*, that we really want to know. It is quite possible to alter the physical properties of a gaseous mixture to a very large extent, while its combustible properties remain scarely changed. Thus, the presence of 6 per cent. of marsh gas in atmospheric air is sufficient to render the mixture explosive in an upward direction, and there may be present in the mixture amounts of carbonic acid from 1 up to 15 per cent. without preventing the mixture from being explosive. Atmospheric air containing 8 per cent. of marsh gas and 8 per cent. of carbonic acid is highly explosive, and yet both instruments above mentioned, as depending for their action upon physical properties of gases, would indicate such a mixture as perfectly harmless, indeed would fail to detect the presence of any combustible gas whatever. On turning to the other class, we have first the flame test; this has, of course, been the practical everyday test employed in collieries for more than a century past; it was applied at a considerable risk before the introduction of the safety lamp, and since that time with comparative security. The tail or cap observable upon a flame when brought into an atmosphere contaminated with inflammable gas is nothing more than a region where, from its situation and close proximity to the flame, the weak mixture of gas and air receives sufficient auxiliary heat to sustain its ignition temperature, or, in plain words, to burn. It is, then, a direct combustion test, and, therefore, on the right principle.

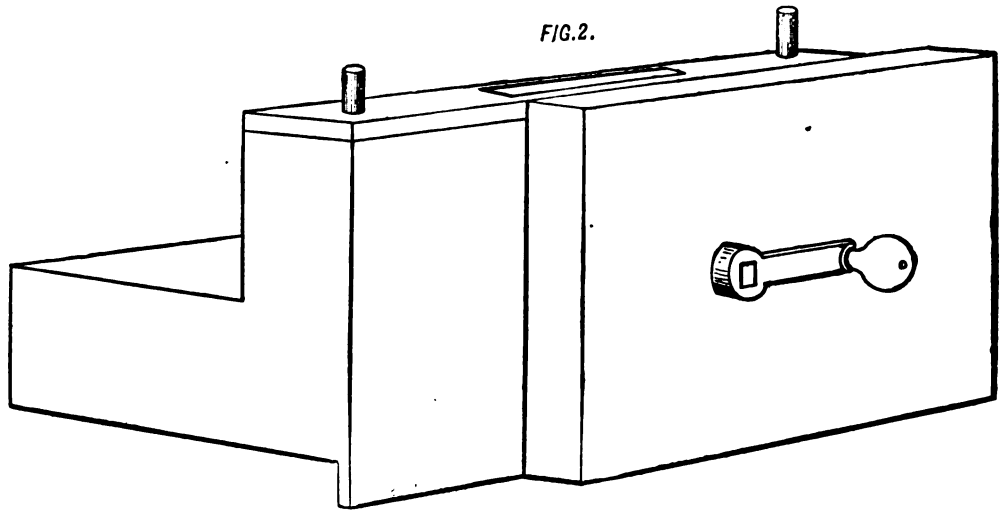
FIG.1



Base of Instrument containing the Magneto Electrical Machine.

The principle on which Mr. Liveing's instrument is based is as follows:—A mixture of marsh gas (fire damp) and air in which the marsh gas forms less than 5 per cent. by volume is not ordinarily explosive, or capable of continuing its own combustion (starting at ordinary temperatures and pressures), simply because the heating value of the marsh gas is insufficient to raise the large excess of atmospheric air to the necessary ignition temperature. If, however, such a mixture is exposed to some sufficiently heated object, especially if that object is platinum, it will burn in its immediate contact and neighbourhood, and in so doing add materially to the temperature of the object, and the more so the larger the percentage of gas present. To apply this principle to the detection and measurement of gas in mines, the arrangement shown in section in Fig. 1 is employed. A B is a narrow box of wood about 8 inches in length, the lid of which is provided with a narrow glass window, C, and also with two short entrance tubes, D and E. At each end of this box is arranged a fine spiral of platinum wire, F and G, through these a current from a small magneto-electrical machine is made to circulate; both wires being in the same circuit, and offering equal resistances to the current and cooling surfaces, become equally heated on turning the machine. One of these spirals is enclosed in a small tube, having a glass end and containing pure air; the other is

FIG.2.



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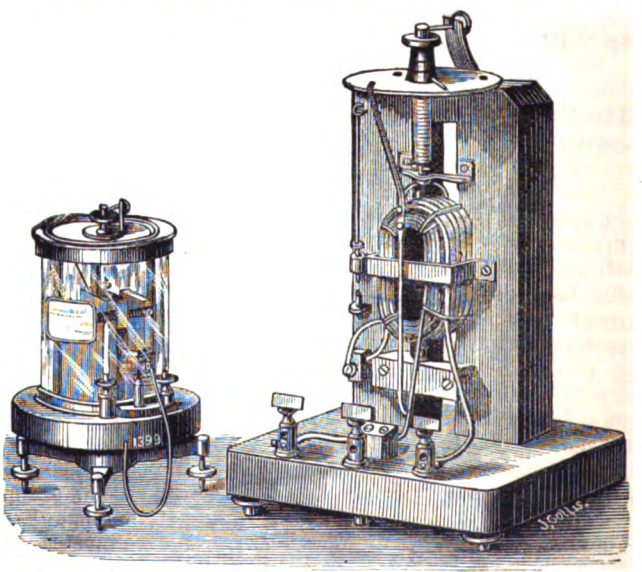
exposed within a small cylinder of wire gauze (also with a glass end), to whatever gaseous mixture is drawn within the instrument for examination. So long as the air examined is free from combustible gas or matter, the two spirals glow with an equal brilliancy, but if the air contain any amount above 1-400th of its volume of marsh gas, the exposed spiral increases in brilliancy, and the more so the nearer the percentage approaches the explosive proportion; and this difference of brilliancy becomes a very delicate test of the presence of gas, as well as a means of determining the percentage present. To measure the difference of brilliancy, a simple form of photometer is provided, consisting of a small wedged-shaped screen, H, the two surfaces of which are illuminated, the one by the covered platinum spiral and the other by the exposed one. The two surfaces are viewed through the window C in the lid, and when the instrument is employed for measuring purposes the screen is moved towards the covered spiral by the slide rod K, until its surfaces appear equally illuminated in the particular gaseous mixture under examination. Within the box, in close proximity to the sliding screen, is placed a scale, L, which gives at once the percentage of gas due to any given position of the screen. The scale is rendered visible by the light from the platinum spirals, which is found sufficient for the purpose. The following table shows the difference of brilliancy due to stated percentages of marsh gas :—

Percentage of CH_4	Relative Illuminating Power of Spirals	
	Covered Spiral.	Exposed Spiral.
Pure Air.....	1	1·
¼ per cent. Marsh Gas	1	1·24
½ „ „ „	1	1·65
1 „ „ „	1	2·78
2 „ „ „	1	5·1
3 „ „ „	1	22·0
4 „ „ „	1	64·0

This table will give some idea of the delicacy and striking character of the test; for it will be seen that in the presence of 2 per cent. of gas (the limit detectable with the lamp) the exposed spiral is five times as bright as the covered one, and that before the explosive proportion is reached it becomes 60 to 70 times as brilliant. In considering the above table it should be borne in mind that the actual results depend much upon the size of the wire, the proportion of the spiral, and other conditions, and can only be determined by actual trial in known mixtures. It is a point worthy of note, that the rate at which the handle is turned within reasonable limits does not sensibly affect the ratio of brilliancy so long as the exposed wire is heated to tolerable redness. With regard to the practical use of the instrument. In modern systems of colliery ventilation the main current of air that descends the downcast shaft is soon sub-divided into separate currents or "splits," as they are called; these passing along the principal travelling ways are conveyed to the different districts where the men are working, and after ventilating a certain number of working places, and becoming more or less contaminated with the gas that is there evolved from the freshly-exposed surface of the coal, are carried by airways known as "returns" to the upcast shaft, often skirting in this part of their course large areas of broken ground (or goaf) where the coal has been more or less perfectly removed. This instrument enables a colliery manager to determine the quantity of gas evolved in the different working districts, and thus to regulate the proportion of his various currents of air, so as to make the best use of the given ventilating power that he has at his disposal. There is, however, another, and perhaps more urgent requirement, which it is hoped this instrument will also meet. In every colliery where gas is liable to be found, the working places and travelling ways leading to them are systematically tested for gas every morning before the men are permitted to go to work; and so also where the hardness of the coal necessitates the use of powder, before each shot is fired the working place and its immediate neighbourhood are tested for gas. These precautions are not only necessary for the sake of safety, but are at the present time enforced by the Coal Mines Regulation Act. For this purpose it is proposed to use the instrument described, and have the screen fixed at some definite percentage, such as 1½ per cent., the one side being marked G and the other A, the directions for use being that so long as the side A of the screen is the brightest the shot may be fired, but if G become equal to or brighter than A the shot should not be fired. Fig. 2 represents the external appearance of the instrument as shown by Messrs. Latimer Clark, Muirhead, and Co. The external form is somewhat peculiar, but it has been designed with a view to facilitate the holding of it firmly when in use in the mine. The observer may hold the instrument either on his knee in a stooping position, or, where there is room, in an erect position, with the instrument pressed against his chest in order to steady it; but the former is, in the inventor's opinion, the best, and in thin seams, of course, imperative. The platinum spirals are so arranged that they can be replaced by anyone with the greatest ease in case of accidental melting or damage. They are mounted on wooden plugs with their respective covers and connections, and provided with metallic terminals that slide behind a pair of metal springs at either end of the indicator box, which serve the double purpose of completing the electrical circuit and retaining the plugs and spirals in position.

Messrs. Siemens show a galvanometer with thick and thin coils for use in measuring large currents, such as are employed in electric light operations. Our illustration is taken from a photograph of the instrument. Attached to the binding screw on the left hand side is one end of a fixed coil, across which a single turn of copper wire with its ends dipping into two mercury cups is freely suspended in a vertical plane, so as to turn about a vertical axis. One is the mercury cup connected to the centre binding screw, the second is connected with one end of the fixed coil, so that between the two binding screws indicated the same current passes through



the fixed coil and suspended wire. On the passage of a current, the wire tends to turn about a vertical axis, but a torsion spring is used to counteract this motion, one end of the wire being attached to the spring the other end of the spring being fixed to a socket carrying an index, which must be moved over a graduated circle, so as to bring the suspended wire back to its initial position. The torsion measuring the action of the current is proportional to the square of the current. These instruments have usually two coils, one of thick wire for continuous currents, the other of smaller wire for alternate currents and currents of high tension.

Messrs. Elliott Brothers have a fine display of instru-

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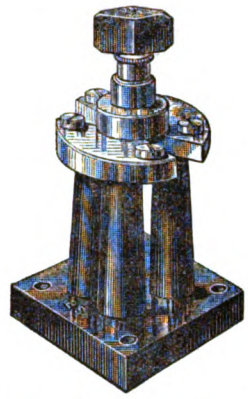
ments of precision, and apparatus connected with electrical measurement, of which we shall have more to say in future numbers. The little instrument illustrated below is a capped



plug. The plug key is mounted on vulcanite pillars, and the semi-circular brass contact pieces made with raised edges at the centre. On this the cap fits, making good contact, and keeping the whole arrangements parallel. The ordinary single plug key is also exhibited. This exhibit includes a large assortment of resistance boxes of various patterns. For a long time the coils in resistance boxes were made of German silver, but Messrs. Elliott Brothers have adopted platinum silver as presenting several

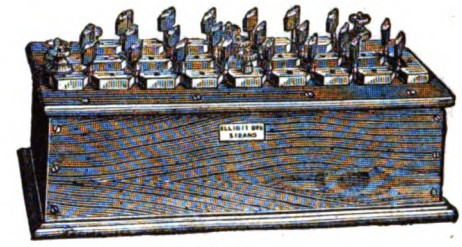


Fig. 1.

valuable features over the German silver. The figures 1 and 2 show specimens of ordinary resistance boxes, while No. 3 shows the Post Office pattern resistance box, arranged with keys, &c., to be used as a Wheatstone bridge. It is almost unnecessary to state that the construction of these coils is in accordance with the well-known excellent workmanship of this firm.

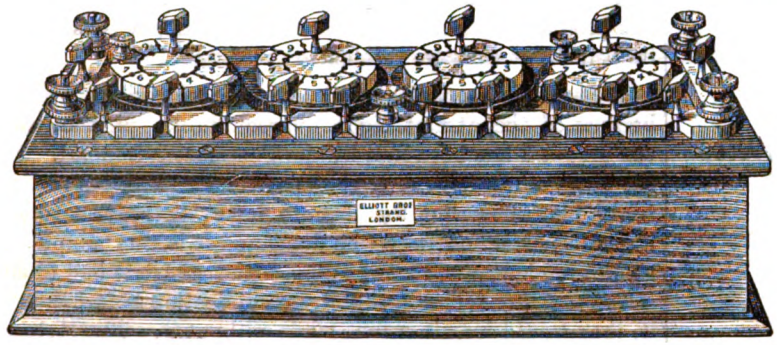


Fig. 2.

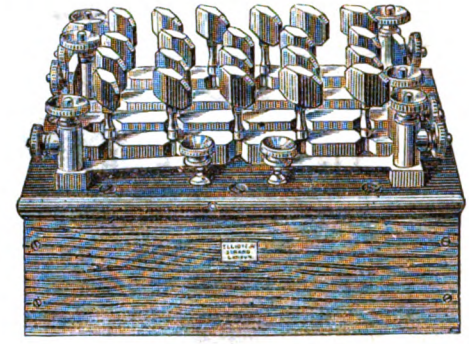


Fig. 3.

THE APPLICATION OF STORAGE BATTERIES TO BALLOONS.

The recent improvements in dynamo-electric machines has suggested to M. Gaston Tissandier, the eminent French aeronaut, that they could conveniently be employed in conjunction with secondary batteries to drive balloons. The secondary batteries of M. Planté, and, better still, of M. Faure, accumulate a considerable sum of energy by means of a relatively small weight. Moreover, the dynamo-electric motor has the advantage of working without any fire, an element which is dangerous to a hydrogen balloon; it offers a constant weight, does not give off any products of combustion, which operate like a discharge of ballast and tend to make the balloon constantly rise. Another point is that the dynamo-electric motor can be started by the mere turning of a handle.

To test the capability of this arrangement M. Tissandier employed the small dynamo-electric machine of the Siemens type, which M. Trouvé has constructed. It weighs only 220 grammes, and its revolving armature was connected by a strap to a double-bladed screw-propeller, made very light, and 0·40 metres in diameter. This little motor was fixed to the lower part of a small balloon, together with a secondary battery weighing 1·3 kilogramme. The balloon was oblong in form, being 3·50 metres in length, and 1·30 metres in diameter. It had a volume of 2,200 litres, and when filled with pure hydrogen gas had an ascending force of about two kilogrammes.

The screw was driven at a speed of $6\frac{1}{2}$ turns per second, and impressed a speed of one metre per second on the balloon in calm air for forty minutes. With two secondary elements mounted in tension and weighing 500 grammes each M. Tissandier adapted to the moter a helix of 0·60 metre diameter, which gave to the balloon a speed of two metres per second during about ten minutes. With three elements the speed attained was three metres.

He renewed the experiments a great number of times at the Conservatoire des Arts et Metiers, and also measured the work done by the little motor. According to the determination of M. Hospitalier and himself it produces in the conditions of maximum labour 90 grammetres with a single element and a speed of five turns per second. With two elements in tension and a speed of 12 turns per second the work attained is 420 grammetres; with three elements it amounts to about a kilogrammetre.

With the two elements in tension, if the speed is lowered to five or six turns per second, the work is no more than 278 grammetres; if it is superior to that which corresponds to to the maximum, and attains 14 turns per second, the work is only 375 grammetres. These experiments show that, conformably to theory, electric motors connected to a generator give a maximum of work corresponding to a certain speed.

It is to be regretted that M. Tissandier did not base his calculations on Faure's accumulator; but they are interesting as they are. He estimates that a dynamo-electric machine giving 6 h.-p. will weigh 300 kilog. and require 9,000 kilog. of Planté secondary battery. An elongated balloon of 3,000 cubic metres volume filled with hydrogen will raise this material easily. The balloon would be 40 metres long by 13·50 metres in diameter at the middle, and its ascending force would be 3,500 kilos. Its weight would be from 1,000 to 1,200 kilos., which would leave 1,000 kilos. or more for ballast and passengers. In calm weather it might be expected to travel at a speed of 20 to 25 kilometres per hour. It would only act during a limited time, but further improvement of the batteries would doubtless extend this period.

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THE ELECTRICIAN.

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WEATHER FORECASTS FOR FARMERS.

Only a few weeks ago we commented upon a proposal for connecting certain mid-ocean islands by telegraph, in order that weather forecasts and meteorological observations might be forwarded and received between those points and the mainland. The wide-spread interest taken nowadays in this class of intelligence, and the service it is seen to render in manifold ways hitherto not suspected, makes it highly probable that the system will be extended to every suitable or accessible spot in the oceans before many years are past.

Meanwhile, the question put to the Postmaster-General a few evenings prior to the close of the Session, asking whether the information supplied to seaports from the Meteorological Office could not likewise be supplied to and posted up at rural telegraph offices, is one of far more importance than the scant attention given to it would seem to indicate. That such a question is asked now for the first time is, perhaps, accounted for by the interests concerned being far remote from the activities of commercial life, in which new ideas and useful appliances soonest find employment. At last, however, those country gentlemen who still, fortunately for us, are compelled to pursue the avocation of farming for pleasure, if not for profit, have cast about them for some means of ameliorating their condition; and as in all probability they attribute the poor harvests rather to bad weather than to bad politics, it has occurred to them that they have a right to the same privileges as are enjoyed by those who "plough the sea." We are decidedly of that opinion ourselves, and if it can be shown—as probably it can—that agriculture would be furthered and its operations safeguarded by timely warning of foul weather, or welcome assurance of fine, these boons ought to be conferred as speedily as possible. It is true we do not ship much of our land produce abroad; if we did, it might be said that we took more pains to protect the ships than to fill them. But we do consume what English produce there is; and it can hardly be said that to increase and protect the sustenance of life is less a national duty than to take care of our merchandise. Of course, we are not forgetting that there are lives as well as merchandise involved in a maritime disaster; but the pursuit of commerce has never been particularly squeamish about human life, so we merely say merchandise. The telegraph has been a great benefactor to the merchant; we desire to see its beneficent message reach also the farmer.

We are the more disposed to argue this point strongly because of the, at first sight, unaccountable spirit in which the proposal has been met by the Postmaster-General. Yes, the farmers can have it if they pay for it. Villages and districts may subscribe together to have the reports sent to them. That is how it can be done, and it is very simple. It strikes us, however, that if villages and districts had to subscribe together for, say, postal communication before they got it, they would remain a long while without it. The Meteorological Office is, we believe, a quasi-governmental department, and certainly its information is at the disposal of the Postmaster-General. But he cannot send it, so he says, because he would be "purveying news," contrary to the Telegraph Acts. The Acts, probably, never contemplated the purveying of weather forecasts; and it is by no means certain that gratuitous warnings could be interpreted as coming within the meaning of the Acts. In any case we cannot imagine any one raising the question; for nobody purveys such news at present, and nobody but the Postal Telegraph department is ever likely to do so. When pressed to state whether Greenwich time is not signalled gratuitously all over the country, Mr. Fawcett replied that such was the case, but when it was sent for "publication"—whatever that may mean—he thought it was charged for. Superfinely scrupulous people who set their watches by post office clocks will take note of this, and in future will, no doubt, remit a small donation to St. Martin's-le-Grand for the accommodation. Ordinary sinners, however, will continue to appropriate such "news" as part of the national benefaction—much as members' wives do the light on St. Stephen's Clock Tower—and may, perhaps, suspect that so indefatigable a reformer as the present Postmaster-General would not have cooled down suddenly but for reasons which are kept in the background. It is a fact that for a number of years past the farmer has been regarded in politics as a personage to be snubbed at every turn, and to be left to his fate at all times. We do not say that the head of the Post Office consciously shares this prejudice; but here is an excellent opportunity for showing that he can rise above it, and we quite believe that he will see reason to relax his ungracious attitude. The initiation of penny savings, the assimilation of postage and revenue stamps, betokened both philanthropy and strength of will; and a little exercise of these qualities on behalf of the agriculturists would easily overcome a mere technical difficulty.

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The boon would be greater, probably, than the class who ask for it themselves imagine, and it is not beyond the powers of Mr. Fawcett to grant it, dubious enactments notwithstanding, if he has a mind to.

The actual cost of signalling these weather forecasts would be very trifling. A few code letters might, we believe, suffice for the particular object in question, and would occupy the wires probably less than does the signalling of time. On a strictly economical view the time signal cannot be said to pay, and we are quite sure a statistician could demonstrate that the operation entails a great loss. But we are not ruled exclusively by economics; and as to statistics we make no doubt they could tell us the exact value of agricultural produce that would be saved if weather signals were instituted. Saving or no saving, however, the gratuitous publication of this class of news would be a kindly act, and one likely to cause the rural population to appreciate the telegraph more than they do at present.

CORRESPONDENCE.

FAURE'S SECONDARY BATTERY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: For the first time since my battery was presented to the public I beg, through the medium of your impartial publication, to give the result of my experiments with it. But first let me dispose of a matter which has wrongly taken prominence in the various controversies on the subject of this battery. I refer to the relative merits of the work done by M. Planté and myself in this subject, and the relative merits of the batteries which bear our respective names.

You will be pleased to learn that neither M. Planté nor myself have had anything to do in these recriminations; in fact, the note which was at first presented by M. Dumas to the French Academy of Science was properly submitted by M. Reynier to the approbation of M. Planté, and kindly revised by the latter, who quite recently again, I have been told, positively disclaimed any connection with the publication of invidious comparisons. Indeed, M. Planté can well afford to be liberal, and hold the same relative position towards the Faure battery as the great founder of the steam engine holds relatively towards the not by any means unimportant engineer who first introduced tubes in the steam boiler. That this comparison is correct we have it on the authority of the words you have italicised in an article on this subject in your last issue.

M. Planté has also the merit of being clear in the exposition of his ideas and researches, and in his remarkable work, "Recherches sur l'Electricité," he tells us exactly how his battery is made, how it is "formed," and what it does when so made. Referring to this last point we read that a battery can furnish a constant current through fifty metres of copper wire one millimetre in diameter, say one ohm during one hour. Now, if we take the electromotive force at 2·20 volts, we find for the work so given out

$$\frac{2{\cdot}20^2}{1 \times 9{\cdot}81} = {\cdot}5 \text{ kilogrammetres}$$

per second during one hour, or an absolute total of 1,800 kilogrammetres. And for the sake of comparison we may also say that the above battery would furnish a current of 2·2 webers for an hour. As Planté batteries may not be in the hands of everyone of your readers, and as I was fortunate enough to obtain an assorted supply before the scarcity set in, I will give a few figures which are the results of my experiments, and somewhat corroborate the above statements. The best cell that I could procure, and which had been nearly two years in formation at the maker's in Paris, gave me when properly charged a current of twenty webers during five minutes. The two lead electrodes are each one millimetre in thickness and 65 millimetres long, by 20 centimetres deep. The amount of suboxide of lead which had been formed upon the positive electrode I found by drying and weighing to be 75 grammes. I will at once here make a comparison. In some of my round cells, having electrodes of the same size as the above, that is 65 × 20, I have placed upon the positive electrode 2,000 grammes of red lead (a similar quantity being also placed upon the *negative electrode*). The current which this arrangement furnished me was about equal to 20 webers during two hours and a half, or nearly proportionate to that furnished by the Planté battery, taking into account the relation $\frac{2000}{75}$ of lead oxide brought into action in both batteries. The least perfect of my Planté cells, which had been "formed" during three months only, gave me only about one fourth of the above work. I state simply facts, but it is said that the above mentioned perfect Planté battery might have been made in three months instead of two years. Let it be so, and let us suppose that the Faure battery has no greater capacity of storage than three or four times that of some of the old Planté batteries in existence, still I beg to say that it exists, and is perfectly well covered by valid patents, and as such will be of great value to the electric industry. Upwards of twenty-five tons of Faure batteries have been made, and experiments on a commensurate scale carried out during a year of silence, and from trustworthy experimental work I have acquired the certitude that there are great things in it.—Yours, &c.,

C. A. FAURE.

THE FAURE SECONDARY BATTERY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: *La Lumière Electrique* asks me to state in what respect the Faure battery differs from that of M. Planté with regard to the reactions produced. There is no difference in kind, but only one of degree. Both batteries, when charged, consist of a plate of lead coated with a layer of the same metal in a spongy condition, and alloyed with hydrogen, and of a second plate of lead coated with a layer of peroxide of lead. But, in the Faure modification of the Planté secondary couple, these layers are considerably thicker, and the duration of the current through a given resistance is, therefore, considerably longer than in the original form of the couple. The Faure battery gives a better result than its prototype, for the same reason that a Planté cell that has been long in use gives a better result than one that has been freshly constructed—viz., because there is a greater thickness of convertible material. The Faure battery is, in fact, an improvement upon the Planté cell—an improvement in virtue of which the lead secondary couple has become in great measure adapted to the requirements of practice. I think that no one is inclined to underrate the claims of M. Planté in connection with this form of secondary battery, and I am sure that M. Faure himself is not inclined to overrate his own improvement. Cannot we render due justice to both workers?—Yours, &c.,

DESMOND G. FITZGERALD.

THE CONTACT THEORY OF THE VOLTAIC CELL.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Does not the following experiment afford an argument against the contact theory of the voltaic cell?

Attach to the terminals of a galvanometer a zinc wire and a copper wire of any convenient size and length. Well wet the hands with, say, dilute sulphuric acid, and with one grasp the zinc wire and with the other the copper wire. Note the deflection of the galvanometer needle.

Now plunge the zinc and copper wires into dilute sulphuric acid, having first disconnected the zinc from the galvanometer. Wet the hands again and grasp with one the zinc and with the other the galvanometer terminal. Note the deflection, and it will be found to be the same as before, with perhaps a very slight difference, due, obviously, to a slight change in resistance.

In the first case there is contact of dissimilar metals, but in the other there is not; yet the deflection is the same in both.

How would a believer in the contact theory explain this?

Yours, &c., J. J. FAHIE.

Shiraz, Persia, July 1, 1881.

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HELMHOLTZ ON POLARISATION.

Professor Helmholtz has recently studied the phenomena of electric polarisation, and some observations made by him on the currents produced by the movement of polarised platinum electrodes are both novel and interesting. As described in "Poggendorff's Annulen," the apparatus employed by him consisted of a voltameter having an unpolarisable electrode and an electrode of platinum. This was connected to a battery of an electromotive force E, which could be made to take any value between + 1^d and − 1^d. A galvanometer was placed in the circuit.

On making E = − 1,000, and leaving things in that state for four or eight days, in order to remove all the hydrogen occluded by the electrode of platinum, then changing the value of E to something between −900 and 0, the electrode will be found to behave like a condenser. For each diminution of electromotive force between these limits there is a short negative variation of current, and for each augmentation a short positive variation. At the same time there exists a very feeble negative current, due to the gas dissolved in the water.

If positive values are given to E, the currents are much more intense, and last whole hours. As the electromotive force is insufficient to decompose the water, the increase of energy is due to occlusion of hydrogen by the platinum. If greater electromotive forces are applied in a transitory manner, then on the return to the former electromotive force, a marked increase of the first current is observed, following a short negative deviation. This phenomenon ceases when the platinum is saturated with hydrogen.

If a return is now made to negative electromotive forces, we have durable currents very different from those at the beginning. They are due to the occluded hydrogen combining with the oxygen; hence their intensity is independent of the resistance, which is considerably modified by the transport of the ions.

In considering the influence of agitating the water along the surfaces of the polarised platinum, Herr Helmholtz calls the current set up by agitation *cathodic* when the cathode is agitated, and *anodic* when the anode is agitated. The primary current must, of course, be distinguished from the agitation current. When the primary current is strong and the cathode disturbed, the agitation current is found to be in the same direction as the primary. When, on the other hand, the primary currents are feeble and either cathodic or anodic the agitation currents are generally anodic. A hydrogen charge on the superficial layers of the platinum favours the anodic direction. When there are two electrodes similarly treated we have in general currents of anodic agitation. An electrode rich in hydrogen tends to give cathordic currents of agitation; one with a middling charge gives strong anodic currents, and one poor in hydrogen gives feeble anodic currents.

According to the latest theory of Professor Helmholtz, to each equivalent of the cation there is connected an equivalent of positive electricity, and to each equivalent of the anion an equivalent of negative electricity. Each electric distribution is correlative with a distribution of ions. That a certain number of positive ions should separate themselves to the neutral and free state, it is necessary that the moiety of them yield up their + E, and take a corresponding quantity of − E. Hence an expenditure of energy.

If the electrolyte is in contact with two electrodes connected to a battery, there is at first an accumulation of ions on the electrodes until the electromotive force of the double layers thus formed counterbalances that of the battery. The electricity which flows until this moment is the charge of *condensation*. The apparatus can discharge itself like a common Leyden jar. Two causes can make this charge disappear.

1. The electrolytic separation of the ions. This takes place when the electromotive force of the battery passes a limit determined by the work to be done. Secondary actions, physical or chemical, can modify this limit. If the electrodes are constituted by the ions themselves, the current will not modify them; hence we have constant batteries. The dissolved gases can act as depolarisers; hence we have currents of convection.

2. The second cause capable of destroying a positive electric layer is the occlusion of hydrogen. This diminishes the work necessary to decompose water. The penetration of hydrogen is a very slow action compared with the heating by conductivity. The conditions of this penetration explain the effect of transitory currents remarked above.

As to the currents of agitation (on the hypothesis of Herr Helmholtz), some are produced by the removal of slightly conducting layers which exist at the surface of the electrodes; others are electro capillary effects resulting from the contact of the water with the glass. The current of water displaces the ions accumulated, and, at the same time, their electric charge. The electric layer can thus increase in thickness sufficiently to discharge itself in setting the ions at liberty. Hence the production of a new current. This explanation supposes that the platinum is feebly positive, and in opposition to acidulated water. The direction of the currents produced by agitation, apart from the primary current, enables the sign of the electric difference between an electrode and electrolyte to be found.

THE INFLUENCE OF ELECTRICAL CURRENTS UPON THE DEVELOPMENT OF PLANTS.

BY WENTWORTH LASCELLES SCOTT, A.S.T.E., ETC.

First Article.

I take the earliest opportunity permitted by the termination of a long period of indisposition and inaction to lay before the readers of *The Electrician* a few preliminary observations upon the subject which is sufficiently indicated by the heading of this article—a subject which, to my thinking, may probably not only open out a comparatively untrodden field of electro-botanical research, but may possibly also lead up to results of a kind calculated to attract the attention of the horticulturist, or even of the practical farmer.

It has, of course, long been known that the sources and manifestations of electric currents were in no way confined to inanimate objects, or even to inorganic bodies; but although "animal electricity" is the well-recognised expression applied to a distinct—indeed, as many try to make it, a *too* distinct—section of the phenomena generally included under the head of electro-chemical force, we have, as yet, no similar title by which currents emanating from or applied to representatives of the vegetable kingdom may be designated. Moreover, while the evolution of electricity by plants has been loosely referred to by many writers in vague and general terms, there has been but little attempt to describe or systematise plant currents as they occur in nature, and still less does there appear any record bearing materially upon the application directly to plants themselves of the force in question.

With the generation of electricity by living plants we have at present nothing to do, so that it is the second half of the question only that need engage our attention at the moment. It need scarcely be said that in some way all the plant, creation are affected by electricity to a greater or a lesser extent, and Hufeland has pointed out that what he calls the voluntary movements of the leaves of the *Hedysarum gyrans*, a *leguminous* plant common in many parts of Bengal, are distinctly accelerated under the influence of both statical and voltaic electricity, as when the prime conductor of an ordinary plate or cylinder is caused to approach them, or also when the — pole of a battery of some power is placed in juxtaposition to one extremity of a plant while the + wire is carefully put in contact with its other end. Still more susceptible to the influence of the "imponderable forces" are the leaves and petioles of the *Mimosa pudica*, the "sensitive plant" *par excellence* of our greenhouses. As has been recorded by Meyer and other observers, a beam of sunlight concentrated by a lens and allowed to fall upon this plant will instantly irritate the coiled fibres of that part of the plant which lies in its path, and cause the pinnules to fold up and the petioles to droop almost as quickly as when roughly touched or shaken. A pencil of "dark heat" rays will occasion a like result, and the application of a powerful bar magnet, as was somewhat vaguely hinted at by Reichenbach, or the near approach of both poles of a large "horseshoe" electro-magnet actuated by an intermittent current, as the writer has observed, will readily excite the "sensation" of this plant and cause marked contraction.

Another phase of the effects of voltaic currents upon the *Mimosa* has not, as far as I know, been noticed before; it is that a continuous current of low tension and insufficient in quantity to cause any movement in the petioles under ordinary circumstances, if allowed quietly to circulate along the main

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stem of the plant, has the property of imparting to the latter a greatly enhanced degree of sensibility, and of rendering the contractile tissue yet more delicately appreciative of the contact of foreign bodies and the impingement upon its surfaces of force-rays or vibrations of any kind. The plant when in this ultra-sensitive condition starts, as it were, into nervous motion upon the very slightest provocation. The drifting against any portion of it of a single spicule of thistledown, the fall of a granule or two of pollen upon one of its leaves, or the swing of a spider-thread upon a petiole is generally sufficient to cause a distinct "shudder," followed by a rapid retraction of the part affected.

The influence does not abruptly cease when the circuit is broken,* but continues, subject to a gradual diminution, for some time afterwards.

It is not, however, to such "drawing-room experiments" as the foregoing that I desire chiefly to draw attention, but they very naturally lead to the inference that if continuous currents impart to the *Mimosæ* so high a degree of additional susceptibility, it is probable that they might exert some important influence upon plants in general, or at least upon certain families or species.

That this assumption is fully warranted by the facts of the case later researches have shown, and I will shortly proceed to cite a few of the results which appear to support my contention.

In the first place, the initial effects of powerful electrical discharges upon trees and shrubs we are, from long observation, pretty well acquainted with; but the destructive influence of lightning scarcely comes within the radius of the present inquiry, for several reasons. The infrequent and momentary character of the phenomenon, the utter disproportion of the electric discharge itself to the comparatively insignificant vegetable semi-conductor through rather than along which it forces a passage with very considerable violence, and the fact that owing to the resistance a part of the fluid becomes converted into heat, all tend to remove lightning from our consideration here.

There is, however, one point in this connection worthy of passing notice. It is this:—When a tree, or plant, becomes the medium through which a thunder-cloud is partly discharged, it is generally either killed or more or less injured thereby, having received an enormous "disruptive" discharge or several smaller ones, in the direction of its downward length or from its apex towards the roots. Again, under certain conditions of the atmosphere known to gardeners and others as "heavy," it frequently happens that evidence of a slow but abundant *downward* discharge may be obtained. At these times vegetation appears to suffer deterioration, or even become "blighted" as the farmers tell us; certainly growth and development of all kinds is at least much retarded.

On the other hand, when plants are in their fullest activity, and the weather is clear and bright, it will be found that the electrical indications are of an "upward" tendency, but little if any earthward induction being apparent.

We have thus, then, faintly and imperfectly shadowed forth the first traces of certain possible laws affecting plant life, which may perhaps be formulated in this manner.

I. *Electric currents of low tension travelling along plant stems chiefly in the direction of their growth excite the development of such plants and increase their vital activity.*

II. *Currents travelling along such plants, chiefly downwards, or in the direction of their roots, exercise a retarding influence upon their development and decrease their vital energy.*

It will be sufficient for the present to place these propositions on record before proceeding further to inquire in what manner such influences are modified by their own simultaneous action, by the irruption of currents not properly included within either class of the preceding, or from other causes.

A few simple experiments have, to my thinking, afforded fair presumptive evidence of the probability of the hypothesis in question. I will preface my account of these by stating at once that my first results upon what might be termed the electrical development of plants were obtained by subjecting them to the influence of floods of light emitted from the electro-pyres in which I am more immediately interested. Dr. C. W. Siemens has, however, descanted upon this part of the subject in his own peculiarly happy and complete manner, and I can only refer the reader to the several papers, lectures, and demonstrations published by the distinguished physicist before-named. That plants are capable of being developed under sunlight and that of the electric arc alike Dr. Siemens has well shown. I shall venture in these columns to give my reasons for believing that plant-vitality may be quickened and enhanced by the agency of the same force applied in a different manner.

(TO BE CONTINUED.)

* This should be done *slowly* by means of a V-shaped contact-breaker or mercurial switch.

CANTOR LECTURES.*

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

BY PROFESSOR W. GRYLLS ADAMS, F.R.S.

LECTURE I.—DELIVERED MONDAY, MARCH 7, 1881.

(CONTINUED FROM PAGE 215.)

This part of the energy, which is spent in twisting the magnetic needle about the axis, leaves less energy to be spent in producing the current, and so there is less current passing in the wire when the magnet is in the act of being deflected than there is in the same wire when there is no magnet. When the magnet is held at rest, or when it has settled into its position of rest, there is no longer any energy spent in keeping it there, and the full current again passes in the wire. Thus a current which deflects a magnet is itself diminished by that motion of the magnet. Take again any of the simple experiments of Ampère on the mutual action of currents of electricity upon one another, and the motion of conductors carrying those currents. There is a conversion of energy of the current into motion of the conductor carrying the current in parallel wires attracting one another, and hence there is less current in the wire while the motion is actually taking place. Thus the approach of two wires carrying currents of electricity diminishes the currents flowing in the wires.

Now, if the approach of these wires diminishes the currents in them, then the separation of the wires may be expected to increase the currents flowing in them, for in the separation work is done in the opposite direction. Hence, in the alternate approach and separation of the wires as they oscillate, the currents are diminished and increased alternately. If there be no current at all in one of the wires, then the separation of the two wires will give a current in the one which had no current in it, and the approach of the wires will give a current in the opposite direction. Thus we are led, by the well-known principles of energy, to results which are well known to be true by experiment, that the separation of the parallel wires, one of which is carrying a current of electricity, produces in the other wire a current of electricity in the same direction or a direct current, and their approach produces a current of electricity in the opposite direction, or an inverse current.

Let us pursue this relation of the principles of energy to the effects produced by electric currents a little further. With two parallel currents in two approaching wires, the amount of energy used up, and therefore producing no effect in the shape of current, depends on the amount required or expended in bringing the wires together. This depends on the rate at which they approach one another. The more rapidly they approach, the more energy is consumed, and the more the currents in the wires are diminished.

In the same way, if the wires are separating from one another, the currents are increased by an amount which depends upon the rate of their separation. Hence, not only their relative motion, but the rate at which they approach and recede from one another, will determine the changes produced in the electric currents in them.

As in the case of bodies falling under the action of the force of gravity, the amount of energy expended is measured by the square of the velocity of falling, so, in the case of currents of electricity in wires approaching one another, the energy expended is measured by the square of the velocity of approach; so that the alteration in the current takes place more and more rapidly as the rate of approach is increased. If, again, we apply this to the case where one of the wires has a current in it, and a second parallel wire has no current in it as long as it remains at rest, then the amount or strength of the direct current in the second wire will increase at a more and more rapid rate as the velocity of separation of the wires is increased, and the strength of the inverse current in the second wire will increase at a more and more rapid rate as the velocity of approach of the wires is increased.

Here, then, we have the laws of the production of induced currents deduced according to the principles of energy from the relative motion of parallel currents, discovered by Ampère. These laws are of such importance in connection with the subject of these lectures, that I shall illustrate them a little farther by a few simple experiments, showing the effect of rate of approach or separation on the induction current.

Instead of actually removing the coils, if the current in the primary circuit be diminished, the effect is the same as if a wire carrying a part of it had been taken away, and so there is a direct current induced in the secondary wire, whereas, if the current in the primary wire be increased, the effect is the same as if a wire

* Reprinted from the *Journal* of the Society of Arts for August, 1881.

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carrying the additional current had approached, and so an inverse current is induced in the secondary wire.

We shall get the greatest rate of separation by suddenly stopping the current in or breaking the primary current, and the greatest rate of approach by suddenly joining or making the current flow in the primary circuit. Hence, breaking the primary circuit produces a very intense rush of electricity, giving a direct current of great intensity in the secondary wire, and making the primary circuit give a powerful inverse current in the secondary wire.

Having shown the relation between the production of currents of electricity by induction and the experiments of Ampère, as we should regard them at the present day in their relation to the principles of energy, let us now consider for a few minutes the way in which they were first produced.

It is now just fifty years ago since Faraday communicated to the Royal Society his first series of papers, entitled:—(1) "On the Induction of Electric Currents," (2) "On the Evolution of Electricity from Magnetism," (3) "On a New Electrical Condition of Matter," and (4) on "Arago's Magnetic Phenomena."

Little did he imagine the marvellous results that were to flow from his experiments when he wrote, at the beginning of that communication, that he had been stimulated to investigate experimentally the inductive effects of electric currents, with the view of elucidating Ampère's beautiful theory of magnetism, and, in the hope of obtaining electricity from ordinary magnetism. In those papers he describes most minutely the details of his experiments, and unfolds, step by step, the laws of an induction current in a helix of wire, called B, placed near to another helix, called A, carrying a voltaic current. That, as long as a steady current was maintained in A, there was no current induced in B; that, on making contact in A, or on approaching the wires, there was a momentary inverse current in B, and, on breaking contact in A, or on separating the wires, there was direct induced current in B; that, as this current was of the nature of an electric wave, like the shock of a Leyden jar, it might magnetise a steel needle, although it produced slight effect on a galvanometer, and how his expectation was confirmed, and that the needle was magntiesed opposite ways on making and on breaking contact.

Then, in his evolution of electricity from magnetism, he gives an account of the greatly increased effects on introducing soft iron cores into his helics of wire, and shows that similar effects are obtained by using ordinary magnets in place of a helix carrying a battery current round an iron core—*i.e.*, in place of an electro-magnet. Also, in place of a cylinder of iron in a helix of wire, he uses a welded soft iron ring, six inches in diameter, and 7-8ths of an inch in thickness, with helics wound round it—in fact, what would now be called a Gramme ring—and remarks that the iron cylinder arrangement was not so powerful as the ring arrangement. Placing the core within the helix, he magnetises it by bringing permanent magnets in contact with its ends, and observes "a deflection which indicates an induced current of electricity in the opposite direction to that fitted to form a magnet, having the same polarity as that really produced by contact with the bar magnets." Such a current would have converted the cylinder into a magnet of the opposite kind to that formed by contact with the poles A and B, and such a current moves in the opposite direction to the currents which, in Ampère's beautiful theory, are considered as constituting a magnet in the position figured. On bringing the bar in contact with the poles of the magnet, a current is induced in the wire in the direction indicated in the figure.

He then describes the experiment of introducing a magnet with a coil of wire, and shows that the same current is obtained whether the marked end of the magnet be introduced at one end of the coil or the unmarked end introduced at the other, and that a current is produced in the opposite direction to the former on withdrawing the magnet from either end.

Then after describing the method of producing his induction spark, and also muscular contractions in a frog by means of a loadstone and coils, which were lent to him from King's College, and remarking that the intensity of the effect produced depends upon the rate of separation of the coil from the poles of the loadstone, he concludes this section thus:—"An agent which is conducted along metallic wires in the manner described, which, whilst so passing, possesses the peculiar magnetic actions and force of a current of electricity, which can agitate and convulse the limbs of a frog, and which finally can produce a spark, can only be electricity."

One other of the discoveries of Faraday, made in that memorable year 1831, we shall find to be of great importance in magneto-electric machines, viz., the difference of time between induction by a battery current in a coil and induction by a magnet, which requires a considerable interval of time to get up to its full strength. Faraday accounted for this retardation by supposing that there is a redistribution of the Ampèrian currents in the iron itself, so that the magnet requires times to rise to its full power.

We may well consider for a while the work of such a man, who, fifty years ago, in his first series of papers to the Royal Society, could establish so many laws of magnetic and current induction, and who made possible the rapid development which is now going on in the science of electricity, and especially in the production of magneto and dynamo machines.

(TO BE CONTINUED.)

BRITISH ASSOCIATION.

Address by Sir W. ARMSTRONG, C.B., D.C.L., LL.D., F.R.S., President of the Mechanical Science Section.

The astonishing progress which has been made in the construction and application of machinery during the half century which has elapsed since the nativity of the British Association for the Advancement of Science is a theme which I might, with much complacency, adopt in this address, but instead of reviewing the past and exulting in our successes, it will be more profitable to look to the future, and to dwell on our failures. It is but justice to say that by growing experience, by increased facilities of manufacture, and by the exercise of much skill and ingenuity, we have succeeded in multiplying and expanding the applications of our chief motor, the steam engine, to an extent that would have appeared incredible fifty years ago, but the gratulation inspired by this success is clouded by the reflection that the steam engine even in its best form remains to this day a most wasteful apparatus for converting the energy of heat into motive power. Our predecessors of that period had not the advantage of the knowledge which we possess of the true nature of heat, and the conditions and limits affecting its utilisation. In their time heat was almost universally regarded as a fluid, which, under the name of caloric, was supposed to lie dormant in the interstices of matter until forced out by chemical or mechanical means. Although Bacon, Newton, Cavendish, and Boyle all maintained that heat was only internal motion, and although Davy and Rumford not only held that view but proved its accuracy by experiment, yet the old notion of caloric continued to hold its ground, until in more recent times Joule, Meyer, Codling, and others put an end to all doubt on the subject, and established the all-important fact that heat is a mode of motion having, like any other kind of motion, its exact equivalent in terms of work. By their reasonings and experiments it has been definitively proved that the quantity of heat which raises the temperature of a pound of water 1 deg. Fahrenheit has a mechanical value equal to lifting 772lbs. one foot high, and that conversely the descent of that weight from that height is capable of exactly reproducing the heat expended.

The mechanical theory of heat is now universally accepted, although a remnant of the old doctrine is displayed in the continued use of the misleading term "latent heat." According to the new theory, heat is an internal motion of molecules capable of being communicated from the molecules of one body to those of another, the result of the imparted motion being either an increase of temperature or the performance of work. The work may be either external, as where heat in expanding a gas pushes away a resisting body, or it may be internal, as where heat pulls asunder the cohering particles of ice in the process of liquifaction, or it may be partly internal and partly external, as it is in the steam engine, where the first effect of the heat is to separate the particles of water into vapour, and the second to give motion to the piston. Internal as well as external work may be reconverted into heat, but until the reconversion takes place the heat which did the work does not exist as heat, and it is delusive to call it "latent heat." All heat problems are comprised under the three leading ideas of internal work, external work, and temperature, and no phraseology should be used that conflicts with those ideas.

The modern theory of heat has thrown new light upon the theory of the steam engine. We now know what is the mechanical value in foot pounds of the heat evolved in the combustion of 1 lb. of coal. In practice, we can determine how much of that heat is transmitted to the water in the boiler, and we are taught how to calculate the quantity which, in the process of vaporisation, takes the form of internal work. We can determine how much disappears in the engine in the shape of external work, including friction, and the remainder, with the exception of the trifling quantity saved in the feed water, we know to be lost. Taking a good condensing engine as an example, we may roughly say that, dividing the whole heat energy into ten equal parts, two escape by the chimney, one is lost by radiation and friction, six remain unused when the steam is discharged, and one only is realised in useful work. It may be fully admitted that the greater part of the aggregate loss is inevitable, but are we to suppose that the resources of science, ingenuity, and skill have been exhausted in the attainment of so miserable a result? Nothing but radical changes can be expected to produce any great mitigation of the present monstrous waste, and without presuming to say what measures are practicable, and what are not, I will briefly point out the directions in which amelioration is theoretically possible, and shall afterwards advert to the question whether we may hope to evade the difficulties of the steam engine by resorting to electrical methods of obtaining power.

To begin with the loss which takes place in the application of heat to the boiler, why is it that we have to throw away at the very outset of our operations twice as much heat as we succeed in utilising in the engine? The answer is that, in order to force a transmission of heat from the fire to the water in the boiler, a certain excess of temperature over that of the water must exist in the furnace and flues, and the whole of the heat below the required excess must pass away unused, except the trifling portion of it which disappears in the production of draught. Further, that since we cannot avoid admitting the nitrogen of the air along with the oxygen, we have to heat a large volume of neutral gas which has no other effect than to rob the fire. Considering what efforts have been made to facilitate the transmission of the heat by augmenting the evaporative surface, and

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using thin tubes as flues, it is vain to expect any great result from further perseverance in that direction, and unless a method can be devised of burning the fuel inside instead of outside the apparatus, so as to use the heated gases conjointly with the steam as a working medium in the engine, a remedy appears to be hopeless. We already practise internal combustion in the gas engine, and it is clear that, with gaseous fuel at all events, we could associate such a mode of combustion with the vaporisation of water. We may even regard a gun as an engine with internally burnt fuel, and here I may remark that the action of heat in a gun is strictly analogous to that of heat in a steam engine. In both cases the heat is evolved from chemical combination, and the resulting pressures differ only in degree. The gun is the equivalent of the cylinder, and the shot of the piston, and the diagrams representing the pressure exerted in the two cases bear a close resemblance to each other. While the powder is burning in the gun we have a nearly uniform pressure, just as we have in the cylinder while the steam is entering, and in both cases the uniform pressure is followed by a diminishing pressure, represented by the usual curve of expansion. If in the steam engine we allowed the piston to be blown out, it would act as a projectile, and if in the gun we opposed mechanical resistance to the shot, we might utilise the effect in a quieter form of motive power. But it is a remarkable fact that such is the richness of coal as a store of mechanical energy, that a pound of coal, even as used in the steam engine, produces a dynamic effect about five times greater than a pound of gunpowder burnt in a gun. I cannot, however, on this account encourage the idea that steam may be advantageously substituted for gunpowder in the practice of gunnery.

And now to turn from the fire which is the birth place of the motive energy, let us follow it in the steam, to the condenser, where most of it finds a premature tomb. From the point at which expansion commences in the cylinder the temperature and pressure of the steam begin to run down, and if we could continue to expand indefinitely, the entire heat would be exhausted, and the energy previously expended in separating the water into steam would be wholly given up in external effect; but this exhaustion would not be complete until the absolute zero of temperature was reached (viz., 461° below the zero of Fahrenheit). I do not mean to say that an ideally perfect engine necessarily involves unlimited expansion, seeing that if instead of discharging the steam at the end of a given expansion, we made the engine itself do work in compressing it, we might under the conditions of Carnot's reversible cycle, so justly celebrated as the foundation of the theory of the steam engine, recommence the action with all the unutilised heat in an available form. But an engine upon this principle could only give an amount of useful effect corresponding to the difference between the whole work done by the engine, and that very large portion of it expended in the operation of compression, and this difference viewed in relation to the necessary size of the engine, would be quite insignficant, and would in fact be wholly swallowed up in friction. Carnot did not intend to suggest a real engine, and his hypothesis therefore takes no cognisance of losses incident to the application of an actual fire to an actual boiler. His ideal engine is also supposed to be frictionless, and impervious to heat except at the point where heat has to be transmitted to the water, and there the condition of perfect conduction is assumed. In short an engine which would even approximately conform to the conditions of Carnot's cycle is an impossibility, and a perfect steam engine is alike a phantom whether it be sought for in the cyclical process of Carnot, or under the condition of indefinite expansion. Practically we have to deal with a machine which, like all other machines, is subject to friction, and in expanding the steam we quickly arrive at a point at which the reduced pressure on the piston is so little in excess of the friction of the machine, as to render the steam not worth retaining, and at this point we reject it. In figurative language we take the cream off the bowl and throw away the milk. We do save a little by heating the feed water, but this gain is very small in comparison with the whole loss. What happens in the condenser is that all the remaining energy which has taken the form of internal work is reconverted into heat, but it is heat of so low a grade that we cannot apply it to the vaporisation of water. But although the heat is too low to vaporise water, it is not too low to vaporise ether. If, instead of condensing by the external application of water, we did so by the similar application of ether, as proposed and practised by M. du Trembley twenty-five years ago, the ether would be vaporised, and we should be able to start afresh with high tension vapour, which in its turn would be expanded until the frictional limit was again reached. At that point the ether would have to be condensed by the outward application of cold water, and pumped back in the liquid state, to act over again in a similar manner. This method of working was extensively tried in France when introduced by M. du Trembley and the results were sufficiently encouraging to justify a resumption of the trials at the present time, when they could be made under much more favourable conditions. There was no question as to the economy effected, but in the discussions which took place on the subject, it was contended that equally good results might be attained by improved applications of the steam, without resorting to an additional medium. The compound engine of the present day does in fact equal the efficiency of Du Trembley's combined steam and other engine, but there is no reason why the ether apparatus should not confer the same advantage on the modern engine, that attended its application to the older form. The objections to its use are purely of a practical nature, and might very possibly yield to persevering efforts at removal.

I need scarcely notice the advantage to be derived from increasing the initial pressure of the steam so as to widen the range of expansion by raising the upper limit of temperature instead of reducing the lower one. It must be remembered, however, that an increase of temperature is attended with the serious drawback of increasing the quantity of heat carried off by the gases from the fire, and also the loss by radiation, so that we have not so much to gain by increase of pressure as is commonly imagined.

But even supposing the steam engine to be improved to the utmost extent that practical considerations give us reason to hope for, we should still have to adjudge it a wasteful though a valuable servant. Nor does there appear to be any prospect of substituting with advantage any other form of thermodynamic engine, and thus we are led to inquire whether any other kind of energy is likely to serve us better than heat for motive power.

Most people, especially those who are least competent to judge, look to electricity as the coming panacea for all mechanical deficiency, and certainly the astonishing progress of electricity as applied to telegraphy, and to those marvellous instruments of recent invention which the British Post Office claims to include in its monopoly of the electric telegraph, as well as the wonderful advance which electricity has made as an illuminating agent, does tend to impress us with faith in its future greatness in the realm of motive power as well.

The difference between heat and electricity in their modes of mechanical action is very wide. Heat acts by expansion of volume which we know to be a necessarily wasteful principle, while electricity operates by attraction and repulsion, and thus produces motion in a manner which is subject to no greater loss of effect than attends the motive action of gravity as exemplified in the ponderable application of falling water in hydraulic machines. If, then, we could produce electricity with the same facility and economy as heat, the gain would be enormous; but this as yet, at least, we cannot do. At present by far the cheapest method of generating electricity is by the dynamic process. Instead of beginning with electricity to produce power, we begin with power to produce electricity. As a secondary motor, an electric engine may, and assuredly will, play an important part in future applications of power, but our present inquiry relates to a primary, and not a secondary employment of electricity. Thus we are brought to the question, from what source other than mechanical action can we hope to obtain a supply of electricity sufficiently cheap and abundant to enable it to take the place of heat as a motive energy. It is commonly said that we know so little of the nature of electricity that it is impossible to set bounds to the means of obtaining it; but ignorance is at least as liable to mislead in the direction of exaggerated expectation as in that of incredulity. It may be freely admitted that the nature of electricity is much less understood than that of heat, but we know that the two are very nearly allied. The doctrine that heat consists of internal motion of molecules may be accepted with almost absolute certainty of its truth. The old idea of heat being a separate entity is no longer held, except by those who prefer the fallacious evidence of their senses to the demonstrations of science. So also the idea of electricity having a separate existence from tangible matter must be discarded, and we are justified in concluding that it is merely a strained or tensional condition of the molecules of matter. Although electricity is more prone to pass into heat than heat into electricity, yet we know that they are mutually convertible. In short, I need scarcely remind you that according to that magnificent generalisation of modern times, so pregnant with great consequences, and for which we are indebted to many illustrious investigators, we now know that heat, electricity, and mechanical action, are all equivalent and transposable forms of energy, of which motion is the essence.

To take a cursory view of our available sources of energy we have, firstly, the direct heating power of the sun's rays, which as yet we have not succeeded in applying to motive purposes. Secondly, we have water power, wind power, and tidal power, all depending upon influences lying outside of our planet. And, thirdly, we have chemical attraction or affinity. Beyond these there is nothing worth naming. Of the radiant heat of the sun I shall have to speak hereafter, and bearing in mind that we are in search of electricity as a cause, and not an effect, of motive power, we may pass over the dynamical agencies comprised under the second head, and direct our attention to chemical affinity as the sole remaining source of energy available for our purpose. At present we derive motive power from chemical attraction through the medium of heat only, and the question is, can we with advantage draw upon the same source through the medium of electricity. The process by which we obtain our supply of heat from the exercise of affinity is that of combustion, in which the substances used consist, on the one hand, of those we call fuel, of which coal is the most important, and on the other of oxygen, which we derive from the atmosphere. The oxygen has an immense advantage over every other available substance in being omnipresent and costless. The only money value involved is that of the fuel, and in using coal we employ the cheapest oxidizable substance to be found in nature. Moreover, the weight of coal used in the combination is only about one-third of the weight of oxygen, so that we only pay upon one-fourth of the whole material consumed. Thus we have conditions of the most favourable description for the production of energy in the form of heat, and if we could only use the affinities of the same substances with equal facility to evolve electric energy instead of heat energy there would be nothing more to desire, but as yet there is no appearance of our being able to do this. According to our present practice we consume zinc instead of coal in the voltaic production of electricity, and not only is zinc thirty or forty times dearer than coal, but it requires to be used in about six-fold larger quantity in order to develop an equal amount of energy. Some people are bold enough to say that with our present imperfect knowledge of electricity we have no right to condemn all plentiful substances, other than coal, as impracticable substitutes for metallic zinc, but it is manifest that we cannot get energy from affinity, where affinity has already been satisfied. The numerous bodies which constitute the mass of our globe, and which we call earths, are bodies in this inert condition. They have already, by the union of the two elements composing them, evolved the energy due to combination, and that energy has ages ago been dissipated in space in the form of heat, never again to be available to us. As well might we try to make fire with ashes as to use such bodies over again as sources of either heat or electricity. To make them fit for our purpose we should first have to annul their state of combination, and this would require the expenditure of more energy upon them than we could derive from their recombination. Water, being oxidised hydrogen, must be placed in the same category as the earths. In short, the only abundant substances in nature possessing strong unsatisfied affinities are those of organic origin, and in the absence of coal, which is the accumulated product of a past vegetation, our supply of such substances would be insignificant. This being the case, until a means be found of making the combination of coal with oxygen directly available for the development of electric energy, as it now is of heat energy, there seems to be no probability of our obtaining electricity from chemical action at such a cost as to supplant heat as a motive agent.

But while still looking to heat as the fountain-head of our power, we may very possibly learn to transmute it, economically, into the more available form of electricity. One method of transformation we already possess, and we have every reason to believe there are others yet to be discovered. We know that when dissimilar metals are joined at opposite ends, and heated at one set of junctions while they are cooled at the other, part of the heat applied disappears in the process and assumes the form of an electric current.

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Each couple of metals may be treated as the cell of a voltaic battery, and we may multiply them to any extent, and group them in series or in parallels, with the same results as are obtained by similar combinations of voltaic cells. The electricity so produced we term thermo-electricity, and the apparatus by which the current is evolved is the thermo-electric battery. At present this apparatus is even more wasteful of heat than the steam engine, but, considering the very recent origin of this branch of electrical science, and our extremely imperfect knowledge of the actions involved, we may reasonably regard the present thermo-electric battery as the infant condition of a discovery which, if it follow the rule of all previous discoveries in electricity, only requires time to develop into great practical importance. Now, if we possessed an efficient apparatus of this description we could at once apply it to the steam engine for the purpose of converting into electric energy the heat which now escapes with the rejected steam and the gases from the fire. The vice of the steam engine lies in its inability to utilise heat of comparatively low grade, but if we could use up the leavings of the steam engine by a supplemental machine acting on thermo-electric principles the present excessive waste would be avoided. We may even anticipate that in the distant future a thermo-electric engine may not only be used as an auxiliary but in complete substitution of the steam engine. Such an expectation certainly seems to be countenanced by what we may observe in animated nature. An animal is a living machine dependent upon food both for its formation and its action. That portion of the food which is not used for growth or structural repair acts strictly as fuel in the production of heat. Part of that heat goes to the maintenance of the animal temperature and the remainder gives rise to mechanical action. The only analogy between the steam engine and this living engine is that both are dependent upon the combustion of fuel, the combustion in the one case being extremely slow, and in the other very rapid. In the steam engine the motion is produced by pressure, but in the animal machine it is effected by muscular contraction. The energy which causes that contraction, if not purely electrical, is so much of that nature that we can produce the same effect by electricity. The conductive system of the nerves is also in harmony with our conception of an electrical arrangement. In fact, a description of the animal machine so closely coincides with that of an electro dynamic machine actuated by thermo electricity, that we may conceive them to be substantially the same thing. At all events, the animal process begins with combustion and ends with electrical action, or something so nearly allied to it as to differ only in kind. And now observe how superior the result is in nature's engine to what it is in ours. Nature only uses heat of low grade, such as we find wholly unavailable. We reject our steam as useless at a temperature that would cook the animal substance, while nature works with a heat so mild as not to hurt the most delicate tissue. And yet, notwithstanding the greater availability of high grade temperature, the quantity of work performed by the living engine relatively to the fuel consumed, puts the steam engine to shame. How all this is done in the animal organisation we do not yet understand, but the result points to the attainability of an efficient means of converting low grade heat into electricity, and in striving after a method of accomplishing that object we shall do well to study nature, and profit by the excellence which is there displayed.

But it is not alone in connection with a better utilisation of the heat of combustion that thermo electricity bears so important an aspect, for it is only the want of an efficient apparatus for converting heat into electricity that prevents our using the direct heating action of the sun's rays for motive power. In our climate, it is true, we shall never be able to depend upon sunshine for power, nor need we repine on that account so long as we have the preserved sunbeams which we possess in the condensed and portable form of coal; but in regions more favoured with sun and less provided with coal, the case would be different. The actual power of the sun's rays is enormous, being computed to be equal to melting a crust of ice 103 feet thick over the whole earth in a year. Within the tropics it would be a great deal more, but a large deduction would everywhere have to be made for absorption of heat by the atmosphere. Taking all things into account, however, we shall not be far from the truth in assuming the solar heat in that part of the world to be capable of melting annually, at the surface of the ground, a layer of ice 85 feet thick. Now, let us see what this means in mechanical effect. To melt 1lb. of ice requires 142·4 English units of heat, which multiplied by 772 gives us 109,932 foot pounds as the mechanical equivalent of the heat consumed in melting a pound of ice. Hence we find that the solar heat operating upon an area of one acre in the tropics, and competent to melt a layer of ice 85 feet thick in a year, would, if fully utilised, exert the amazing power of 4,000 horses acting for nearly 9 hours every day. In dealing with the sun's energy we could afford to be wasteful. Waste of coal means waste of money, and premature exhaustion of coal beds. But the sun's heat is poured upon the earth in endless profusion—endless at all events in a practical sense, for whatever anxiety we may feel as to the duration of coal, we need have none as to the duration of the sun. We have, therefore, only to consider whether we can divert to our use so much of the sun's motive energy as will repay the cost of the necessary apparatus, and whenever such an apparatus is forthcoming we may expect to bring into subjection a very considerable proportion of the 4,000 invisible horses which science tells us are to be found within every acre of tropical ground.

But whatever may be the future of electricity as a prime mover, either in a dominant or subordinate relation to heat, it is certain to be largely used for mechanical purposes in a secondary capacity, that is to say, as the offspring instead of the parent of motive power. The most distinctive characteristic of electricity is that which we express by the word "current," and this gives it great value in cases where power is required in a transmissible form. The term may be objected to as implying a motion of translation analogous to the flow of a liquid through a pipe, whereas the passage of electricity through a conductor must be regarded as a wavelike action communicated from particle to particle. In the case of a fluid current through a pipe the resistance to the flow increases as the square of the velocity, while in the case of an electric current the resistance through a given conductor is a constant proportion of the energy transmitted. So far, therefore, as resistance is concerned, electricity has a great advantage over water for the transmission of power. The cost of the conductor will, however, be a grave consideration where the length is great, because its section must be increased in proportion to the length to keep the resistance the same. It must also be large enough in section to prevent heating, which not only represents loss but impairs conductivity. To work advantageously on this system a high electromotive force must be used, and this will involve loss by imperfect insulation, increasing in amount with the length of the line. For these reasons there will be a limit to the distance to which electricity may be profitably conveyed, but within that limit there will be wide scope for its employment transmissively. Whenever the time arrives for utilising the power of great waterfalls, the transmission of power by electricity will become a system of vast importance. Even now small streams of water inconveniently situated for direct application, may, by the adoption of this principle, be brought into useful operation.

For locomotive purposes, also, we find the dynamo electric principle to be available, as instanced in the very interesting example presented in Siemens's electric railway, which has already attained that degree of success which generally foreshadows an important future. It forms a combined fixed engine and locomotive system of traction, the fixed engine being the generator of the power and the electric engine representing the locomotive.

Steam power may both be transmitted and distributed by the intervention of electricity, but it will labour under great disadvantage when thus applied, until a thoroughly effective electric accumulator be provided, capable of giving out electric energy with almost unlimited rapidity. How far the secondary battery of M. Faure will fulfil the necessary conditions remains to be seen, and it is to be hoped that the discussions which may be expected to take place at this meeting of the British Association will enable a just estimate of its capabilities to be formed. The introduction of the Faure battery is at any rate a very important step in electrical progress. It will enable motors of small power, whatever their nature may be, to accomplish, by uninterrupted action, the effect of much larger machines acting for short periods, and by this means the value of very small streams of water will be greatly enhanced. This will be especially the case where the power of the stream is required for electric lighting, which in summer, when the springs are low, will only be required during the brief hours of darkness, while in winter the longer nights will be met by a more abundant supply of water. Even the fitful power of wind, now so little used, will probably acquire new life when aided by a system which will not only collect, but equalise, the variable and uncertain power exerted by the air.

It would greatly add to the utility of the Faure battery if its weight and size could be considerably reduced, for in that case it might be applicable to many purposes of locomotion. We may easily conceive its becoming available in a lighter form for all sorts of carriages on common roads, thereby saving to a vast extent the labour of horses. Even the nobler animal that strides a bicycle, or the one of fainter courage that prefers the safer seat of a tricycle, may ere long be spared the labour of propulsion, and the time may not be distant when an electric horse, far more amenable to discipline than the living one, may be added to the bounteous gifts which science has bestowed on civilised man.

In conclusion, I may observe that we can scarcely sufficiently admire the profound investigations which have revealed to us the strict dynamical relation of heat and electricity to outward mechanical motion. It would be a delicate task to apportion praise amongst those whose labours have contributed in various degrees, to our present knowledge; but I shall do no injustice in saying that of those who have expounded the modern doctrine of energy, in special relation to mechanical practice, the names of Joule, Clausius, Rankine, and William Thomson, will always be conspicuous. But up to this time our knowledge of energy is almost confined to its inorganic aspect. Of its physiological action we remain in deep ignorance, and as we may expect to derive much valuable guidance from a knowledge of Nature's methods of dealing with energy in her wondrous mechanisms, it is to be hoped that future research will be directed to the elucidation of that branch of science which as yet has not even a name, but which I may provisionally term "Animal Energetics."

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Town Hall, Waterford, August 12th, 1881.

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OF THE

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RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

225. IMPROVEMENTS IN ELECTRIC LAMPS, AND IN THE MEANS OF TURNING ON OR OFF THE ELECTRIC CURRENTS, &c., *St. G. L. Fox.*—18*th January*, 1881. 6*d*.

The latest form of lamp is seen in the first figure. The contacts between the carbon filament and the platinum holder are made with Indian or Chinese ink, and this is the first claim. The method of carbonising the thread, string, or vegetable fibre used, is claimed. A grooved graphite cylinder, into which a strip of serrated steel has been placed, so that the serrations are just above

the normal level, is taken, the thread wound on it, and intensely heated in an hermetically closed crucible. The thread contracts, and is cut by the steel into equal lengths. The threads thus obtained are rendered incandescent by means of an electric current, and their resistance lowered to the point required. A thickening of the ends of the wire is obtained by electro-deposition of carbon, thick ends being required for good contacts.

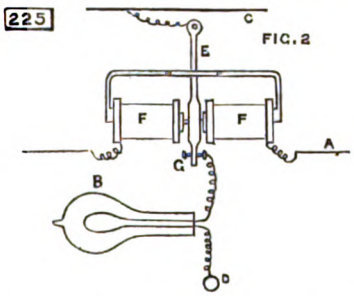


FIG. 2

One form of the apparatus for current operations is shown in Fig. 2. It consists of a permanent magnet, E, and an electro-magnet, F. The coils of F form part of the circuit of the line wire A. On sending a current through the line wire the movement of the magnet at every lamp in the series is caused, by coming in contact with peg G or moving from it, to turn on or off the current.

245. IMPROVEMENTS IN APPARATUS FOR LIGHTING GAS, *C. L. Clarke and J. Leigh.*—22*nd January*, 1881. 4*d*.

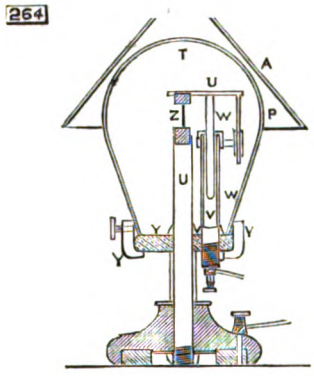
This invention refers to improvements on the electric lamp for gas lighting, patented on the 1st June, 1880, No. 2,229. The improvement consists in the construction of the battery and the method of preparing the wire of the induction coil. The battery is formed of thin silver foil, coated with dry powdered chloride of silver, kept in place by being wrapped in blotting paper. Zinc plates are then laid on the sides of the plate thus formed. The whole is then wrapped in blotting paper and strapped by two or three elastic bands. After being pressed it is placed in a cell containing a solution of chloride of zinc. To give greater conductivity to the iron wire of the induction coils, it is taken in the tank and wound on to a tubular iron bobbin. Two or three layers of coarser wire are then wound above it for protection. It is then placed in a furnace, raised to nearly welding heat, then withdrawn and immediately plunged into a vessel containing powdered charcoal, and covered over so as to entirely exclude the atmosphere, being afterwards allowed to gradually cool. After this it is saturated with paraffin, wound off the bobbin, and formed into a coil.

253. PRODUCING ELECTRIC CURRENTS, AND APPLYING THEM FOR ILLUMINATION AND FOR TRANSMISSION OF POWER, *C. G. Gumpel.*—20*th January*, 1881. 10*d*.

To produce the currents the inventor constructs a dynamo-electric or magneto-electric machine, so as to obtain with a given velocity of the rotating armature more numerous and powerful currents than are usually produced, at the same time avoiding heating of the coils. The armature is made in the shape of a hollow open-ended shell of magnetic material, the middle being larger than the ends. The ends are divided by projecting fins. The shell is formed of a number of rings fixed on a shaft electrically insulated from one another, each ring being provided with the necessary peripheral projections like teeth, so that when the rings are placed together to build up the shell, these projections corresponding to each other form the ribs or magnetic extension pieces. These ribs divide the surface of the armature into sections for the reception of the insulated conducting wires, the method of winding which is then described. The inventor also describes his mode of applying the current generated by his machine to the steering of ships.

264. APPARATUS FOR PRODUCING LIGHT BY ELECTRIC CURRENTS AND FOR GENERATING AND MEASURING SUCH CURRENTS.—*A. Apps.*—21*st January*, 1881. 6*d*.

The first part of this patent refers to a dynamometer, which measures the force with which two platinum studs are brought into contact (the manner of contact being effected according to a former patent No. 177, 1867). The dynamometer is constructed on the spring-balance principle, and is furnished with a gauge indicating in customary measurements of force the maximum power or variations of the currents. The second portion refers to the multitubular form of magnet and of conductor contained within the inductor, which secures better insulation than heretofore. The



third part refers to apparatus for the production of light, which the inventor constructs as follows:—T is a closed vessel, U U^1 are two holders, the first being stationary, and the other movable. Rod W has a platinum stud screwed into the ends, by which contact is made with the mercury in tube V. A light guide rod moving in a suitable guide maintains the proper axis of the parts during the descent of the holder U^1 in relation to U; glass plate Y sustains the rods and fittings, and forms a convenient base. A ring holder Y^1, with lugs and suitable screws, fixes down the vessel to the glass base plate. Oxygen is consumed quickly on passing a current through Z, which may be of carbon or other conducting matter. A is a glass reflector.

286. IMPROVEMENTS IN TELEPHONES, *F. H. F. Engel.*—22*nd January*, 1881.—(*A communication from J. H. Konigslieb.*) 4*d*.

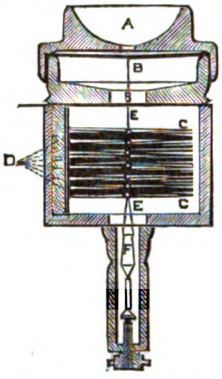
The object of this invention is to increase the power of transmitting and receiving sounds by the telephone. Instead of making that part of the casing of a telephone which is below the diaphragm massive, a thin walled wooden box is placed beneath the diaphragm, and a second casing of wood is placed beneath and some distance apart from this box, this casing forming a sounding-board. The magnet may be passed from below through the bottoms of both box and casing into the free space beneath the diaphragm, or it may be introduced into the sounding-board through the upright circumference sideways, and the ends of the magnet, which must in this case be bent at right angles, will be introduced through the bottom of the box into the free space between box and diaphragm. The sounding-board may have sound-holes in it.

304. CARBON AND GRAPHITE, &c., *R. Werdermann.*—22*nd January*, 1881. 6*d*.

This relates to the manufacture of carbon by carbonising a mixture of sugar, wood pulp, cotton, hemp, flax, or the like, with oil, resin, tar, or other hydrocarbon.

760. IMPROVEMENTS IN TELEPHONES, *E. W. Anderson.*—23*rd February*, 1881.—(*A communication from J. Goodman.*) 6*d*.

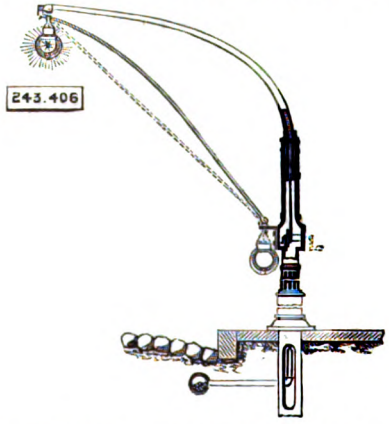
The inventor connects the diaphragm to the magnet by flexible connections and elastic devices, and also by inflexible connections without the latter. The figure refers to the former. D represents the magnets, which are fastened at intervals by one end to the post H, located near the end of the helices C. In this construction two flattened helices are employed, their long sides parallel with each other, one being a left and the other a right hand helix. These are designed to affect the magnets between them in the same manner that a single coil would. The ends of the magnets opposite H are free to move. B is the diaphragm, A ear-piece, and E a cord in connection extending



from B to spring F. E is connected in its course to the middle portions of the magnets, which are, therefore, held in tension between B and F, thus holding them parallel to the wires of coils C. This tension may be regulated by screw G. If the instrument is applied to the ear and the circuit suddenly closed by metallic connection, the current in the coil will overcome the tension of the spring, and the points of the magnets will be deflected, and this movement being propagated by the cord E, the diaphragm will be effected and give out a sharp click sound. Another arrangement is to make the magnets themselves elastic or flexible, and so dispense with the spring.

243,406. ELECTRIC LAMP SUPPORT, *Henry C. Sample and Franz Rabl, Philadelphia, Pa.*—*Filed April 11th*, 1881.

Claim.—In an electric lamp support, a vertical column or post, in combination with a curved arm at the top, said arm projecting over the curbing



and partly over the roadway, and an electric lamp adapted to be raised or lowered to or from the end of said arm, and at all times insulated therefrom, substantially as and for the purpose specified.

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By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

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SLIP

ELECTRIC LIGHT AT SCARBOROUGH.—The Brush light has been tried for some days now as a means of lighting the promenade at Scarborough.

DIRECT SPANISH TELEGRAPH COMPANY.—Traffic receipts for the month of August were £1,507, against £1,197 in the corresponding period of last year.

THE FAURE SECONDARY BATTERY.—This battery is being shown in the Exhibition Hall at York, on the occasion of the meeting of the British Association.

FEMALE CLERKS IN THE CIVIL SERVICE.—An article on this subject, by Miss Harkness, appears in the September number of the *Nineteenth Century*.

ELECTRIC LIGHT ON SHIPBOARD.—It is stated that the new steamship "City of Worcester," built for the Norwich line, is to be fitted up with 270 of the Edison electric lamps.

ELECTRIC LIGHTING FOR HOUSES.—It is stated that the "Falstaff Club," situate in Covent Garden, are going to illuminate their premises and theatre adjoining by means of the electric light.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this company for the week ended the 26th ult. amounted to £3,177, and for the week ended the 2nd September to £3,207.

EASTERN EXTENSION TELEGRAPH COMPANY.—The traffic receipts of this company for the month of August amounted to £30,349, against £30,169 for the corresponding period of 1880, being an increase of £180.

EASTERN TELEGRAPH COMPANY.—The traffic receipts of this company for the month of August last amounted to £42,797, against £40,988 in the corresponding period of 1880, being an increase of £1,809.

ELECTRICAL TRAMWAY IN WIESBADEN.—It is proposed to construct an electrical tramway at Wiesbaden, in Germany. It would serve as an extension of the tramway line from the colonnades across the Capellenstrasse on the Neroberg.

ELECTRIC LIGHT AT NORWICH.—The Town Council have been so pleased with Mr. Crompton's lamps as erected in the market place, that they are about to extend them down the Prince of Wales's-road, which leads towards the station.

WEST INDIA AND PANAMA TELEGRAPH COMPANY.—The estimated traffic receipts of this company for the half month ended August 31 were £1,758, as compared with £533 in the corresponding period of 1880. The June receipts, estimated at £4,743, realised £4,995.

SHANGHAI-AMOY CABLE RESTORED.—The Great Northern Telegraph Company give notice that the Shanghai—Gutzlaff—Amoy cable, which we noticed last week as being interrupted, has been repaired. They also state that their Japanese lines are in perfect working order.

THE PARIS EXHIBITION.—BRITISH SECTION.—We notice that the Society of Telegraph Engineers and of Electricians have published a special number of the *Journal*, which forms a guide book to the British Section of the Paris Exhibition. It also contains descriptions of the exhibits.

GREAT NORTHERN TELEGRAPH COMPANY.—The traffic receipts of this company for August were £21,200, and for period from the 1st January to 31st August, £157,440; against £154,075 for the corresponding months of 1880, and £133,400 for the corresponding month of 1879.

ELECTRIC LIGHT FOR LIGHTHOUSES.—The first of the series of lighthouses round the French coast which are to be henceforth illuminated by electricity, has, with all its necessary machinery, been completed. It is called the "Phare de Planier," and is situated at the mouth of the Rhone, near Marseilles.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this company for the week ending the 26th August, were £2,052, and for the week ending the 2nd September to £2,086, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company.

ELECTRIC LIGHT AT HOBOKEN.—On the 16th the Brush Electric Light Company's proposal to light Hoboken for 9,000 dollars for five years was laid over for a week at the meeting of the Common Council, and it will probably be accepted at the next meeting of the board.—*Engineering News*, New York, Aug. 20.

THE ELECTRICAL TRAMWAY AT PARIS.—Messrs. Siemens's electrical tramway, which runs right into the Exhibition, appears to be a great success, people being very anxious to be transported by means of the mysterious agency which our friends on the other side of the channel have named the "Queen of the Nineteenth Century."

PRICES.—The prices as quoted are, for gutta percha per lb.: —Genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber per lb.: Fine Para, 3s. 3d. to 3s. 4d.; negrohead, 1s. 11d.; central American, 1s. 6d. to 2s. 2½d.; Assam and Pegu, 8d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 4d. to 2s. 1½d.

NEW OBSERVATORY.—A meteorological station is to be erected at Pavia, under the direction of Professor Cantoni. Investigations will be made at this station on the influence of heat, light, electricity, &c., on vegetation in general, and some cultivations in particular, and also on the diurnal and annual variations of terrestrial magnetism.

CUBA SUBMARINE TELEGRAPH COMPANY.—The number of messages passing over the lines of this company during the month of August was 2,354, estimated to produce £2,300, against 1,808 messages, producing £1,886 in the corresponding month of last year. The traffic receipts for the month of June, estimated at £2,700, realised £2,837.

"PASTURES NEW."—News from Cape Town says that the *Eastern Star* has been complaining that gas motors were not available because there was no gas, and recommending electric motors whose store of power can be accumulated by an inexpensive windmill or waterwork arrangement. It adds that Colonel Beaumont's air-engines are likely to supersede the latter.

ELECTRIC LIGHT AT YORK.—The Brush electric light was exhibited at York this week on the occasion of the visit of the British Association. The light did not work very well, though this may reasonably be put down to the fact that at the last moment the locality of the generator had to be shifted, and the engine turned out to be of insufficient power to keep the lights going

OVERHEAD WIRES.—The committee appointed by the St. George's (Hanover-square) Vestry to consider this question

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have reported "that most of these wires were put up before the passing of the Act which talked about the responsibility of the local authorities, and that, all things considered, the committee did not see that any moral or legal responsibility rested with the Vestry."

AMERICA TO THE FORE.—We have it on good authority that Mr. Edison's agents are offering to fit up shops in the West End of London with his incandescent lamps for six months, free of all charge, and unconditionally. One or two well-known West End firms have already consented to try the experiment. Yankee enterprise has given us a lesson here which should not be lost.

DELEGATES TO THE INTERNATIONAL CONGRESS. — The German Government has appointed the following gentlemen to take part in the electrical congress at Paris, viz.:—Dr. Foster, of Berlin; Dr. Brix, telegraph engineer, of Berlin; Dr. Helmholtz, of Berlin; Dr. Weber, of Gottingen; Dr. Wiedemann, of Leipzig; Dr. Toepler, of Dresden; and Dr. Voller, Director of the Physical Laboratory, Hamburg.

POSITIVISM.—At a recent meeting of the Derby Gas and Coke Company Mr. Hawksley, the engineer to the company, is reported to have said that "he considered the electric light absolutely inadaptable to the lighting of houses." This is rather positive in the face of the electrical illumination of Mr. Spottiswoode's, Sir W. Armstrong's, and other private houses by means of the incandescent lamp.

WHEATSTONE'S TELEGRAPH IN PARIS.—*La Liberté* says that the Wheatstone and Cook telegraph was first tried at the Saint Lazare Station a short time before the death of the Duke of Orleans, who was present at the trial. The experiment was carried out by Messrs. Pereire Brothers, who also established the first line between Paris and Rouen *L'Electricité* suggests that a tablet commemorative of this should be placed in the station.

RADIOPHONY.—Under the title of "Indirect Radiophony," that is to say, in the case in which electricity is employed as an intermediary, M. Mercadier, in *La Lumiere Electrique* for the 3rd of September, recapitulates his experiments, and compares them with those of Messrs. Bell and Tainter, in. Washington, and concludes by saying that in his opinion both his own and their experiments point the same way and to the same conclusion, albeit there was some difference in the method of conducting them.

LOANS FOR ELECTRIC LIGHTING PURPOSES.—Among the borrowing powers conferred by Parliament last year are some which have reference to the electric light. For this purpose, Burton-upon-Trent took power to borrow £5,000; Lancaster, the same; Preston, £10,000; and Wigan, £20,000; the loan in each instance to be repaid in ten years. Huddersfield, in taking power to borrow £50,000 for the purchase of gas-works, obtained the option to expend £20,000 on the electric light, the sum so applied to be repaid in the usual period.

THE ELECTRIC LIGHT FOR RIVERS.—News from America says that amongst the latest uses to which it is proposed to put the electric light is the illumination of rivers to permit the rafting of logs at night. The Muskegon Boom Company will be the pioneer in this direction. In Baltimore experiments have been made with a view of illuminating water at night to a depth of 200 feet. Such a means of illumination, it is believed, would be of great service in searching for lost treasure and drowned persons, in raising wrecks, removing torpedoes, and in other subaqueous labours.

COST OF THE ELECTRIC LIGHT.—With reference to the query of J. F. in our issue of the 27th of August as to the cost of the electric light, Messrs. Hammond and Co., the concessionaires of the Brush system in the North of England write to us as follows:—"From our experience in working the 'Brush' light at various works, we find that under this system the light costs, when worked for 3,600 hours per year, almost exactly 2d. per light of 2,000 candles per hour, and in this figure is included 10 per cent. for interest and redemption, cost of coals, wages, carbons, &c."

MAGNETS.—M. Trouvé finds that if three steel bars of the same length and size are magnetised, then demagnetised, and afterwards remagnetised, the magnetic power due to the first magnetisation being represented by 2, 3, 4, the power of the second will be 4, 9, 16. He found it necessary to demagnetise very regularly. To magnetise the bars he placed them in two solenoids in juxtaposition, closed the magnetic circuit by means of two soft iron plates, and caused a current to pass from a battery of six Wollaston cells. He thus obtained magnets of great constancy. He states that straight magnets support twelve or fourteen times their weight; if the magnet be of horseshoe form it will support forty-eight or fifty-six times its own weight.

TELEGRAPH COMMUNICATION WITH LIGHTSHIPS.—A daily contemporary in a recent article on this subject says:—"It would be easy to carry a telegraph wire on to a ship moored stem and stern, like the 'Warspite' or the 'Shaftesbury' in the Thames, but of course no vessel could live in a rough sea if thus secured. The lightships are moored so as to swing round with the tide, and moreover they have a marvellously ingenious contrivance by which under the stress of a storm they gradually pay out cable, thus giving way inch by inch to the full violence of the wind and waves. After a long and severe storm they will have perhaps a quarter or half a mile of chain thus paid out, and it is easy to perceive what a complicated tangle of cable and wire might result from this process while the ship was swinging round with the tide." We shall illustrate a method of surmounting this difficulty in a future number.

ACCIDENTS BY LIGHTNING.—News from Naples says that on the 29th ult. the parish church of Stacchetta, five miles from Brescia, was struck by lighting, which had been attracted by an iron cross on the clock tower. The lightning, after tearing off the hands of the church clock, entered the church near the pulpit, where the curate, Don Guiseppe Bovo, was preaching before a densely-packed congregation, who were completely paralysed by the effect of the lightning and the fearful clap of thunder following. Many people were thrown down violently, others lifted from the pavement or thrown upon one another, and a young workman, Vitali Camillo, was instantaneously killed. The lightning entered on his left side, drove his silver watch into his ribs, ran down his left leg, tearing up the seams of his trousers, and took off his heavy boots. We also hear of a violent hurricane, accompanied by thunder and lightning, which is said to have taken place at Galantha, near the Little Carpathians, in Hungary, by which the village was almost entirely destroyed; several houses were set on fire by the lightning.

RAILWAY SIGNAL APPARATUS.—On the occasion of the opening of an additional line on the Great Western Railway between Uxbridge and West Drayton, on Tuesday last, an electrical signal apparatus, the invention of Mr. Spagnoletti, chief of the electrical department of the Great Western Railway, was brought into successful operation between the West Drayton Junction and Uxbridge Station. The object of the apparatus, which has received the approval of the directors, is the interlocking of the out-door semaphore sig-

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nals with the block telegraph system by electrical and mechanical means, the trains themselves taking part in the working. Its mode of application was exemplied as follows:—Uxbridge having a train ready to leave the station signalled a couple of "beats" to the West Drayton box, when the officer there in charge replied with four beats, pressed the "plunger," and took off the lock at Uxbridge signals, and thus permitted the up train to leave the terminus, the line being clear between the latter place and West Drayton. As the train neared the signal box at West Drayton a slight deflexion of the rails at a certain point communicating by a mechanical arrangement with an indicator in the cabin published the fact that the line was "clear," though no second train could still be despatched from Uxbridge till the lock was again taken off its signals by the man in the West Drayton box. In the same way no train could leave West Drayton Junction till the lock had been electrically removed from its signal lever by the signalman at Uxbridge, the apparatus, in every instance after the departure of a train, becoming relocked, thus preventing any possibility of a second train following and coming into collision with the first, as before another would be allowed to quit the station the lock would have again to be taken off the lever by the signalman at the end of the section, who, if a train had broken down or met with an accident, would not release it, having had no intimation that the line was "clear," in consequence of the non-arrival of the train at the indicating point beneath the metals in the vicinity of his cabin. So perfect is the apparatus beneath the deflecting rail that the number of the carriages comprising the trains could be counted by the vibration of the wheels heard distinctly in the signal box as the vehicles passed along the line to West Drayton Station.

Programme of the International Congress of Electricians.—The following programme has been drawn up by the committee appointed for that purpose at a meeting of the French members of the Congress held on the 1st of August. The Congress will be divided into three sections as follows:—1. Natural philosophers, chemists, physiologists, and those persons generally who study electricity from the theoretical point of view. 2. Telegraphists and railway engineers. 3. Electricians and engineers who are occupied in the other civil and military branches of applied electricity. Members of the Congress can belong to more than one section. The sectional meetings will all take place at different hours, so that all members can take part in them. Congress meetings will include—1. General meetings to discuss questions of an international character, and requiring a vote of the congress; 2. Sectional meetings to discuss questions of special interest which require exchange of opinions, &c.; 3. Public meetings, in the shape of conferences, in which members of congress who may be willing to do so, may lecture on any question of present interest. Under the head of general meetings, Part I., we find the following put down as questions to be submitted to the Congress; 1. Electrical units, the measures to be taken to establish the adoption of an international system of electrical units, (*a*) the necessity for unanimity in the adoption of a general international system of electrical measures, (*b*) the choice of units and their denomination, (*c*) the measures to be taken for the establishment, preservation, and reproduction of international standards, (*d*) should not an international commission be appointed for this purpose? (*e*) could not this commission be assimilated with that of the International Bureau of Weights and Measures? 2. International telegraphy, the measures to be taken to improve international telegraphy, (*a*) the employment of the same terms and the same units to indicate the elements influencing the working of international lines, (*b*) will it be possible to organise an international study of earth currents, (*c*) conventions for regulating the conditions for laying submarine cables, (*d*) the establishing of conventions referring to distinct signals and rules for the navigation of vessels laying or repairing cables. 3. Various applications of electricity, the measures to be taken to facilitate international scientific relations as regards certain special applications of electricity; (*a*) electric light, for facilitating the comparison of luminous intensities; (*b*) electrophysiology, for facilitating the comparison of effects obtained by the use of electro-medical apparatus; (*c*) lightning conductors, to facilitate the aggregation of comparative statistics on the merits of the various systems of lightning conductors in use. Part II. Sectional meetings. Special questions for discussion—Section 1: Theory, sources of electricity, lightning conductors, electro-physiology, (*a*) the theory of electricity, (*b*) the measurement of continuous or alternate currents of great intensity, (*c*) atmospheric electricity and terrestrial magnetism, (*d*) the best conditions for erecting lightning conductors. Would it be possible to aggregate the elements of international statistics concerning the merits of the different systems in use? (*e*) the necessity for defining in scientific terms the currents used in medical operations, and to give the measurements in electrical units. The best means to be employed for determining the nature of electrical phenomena which are produced in animals, (*f*) questions to be introduced at the discretion of members. Section 2: The transmission of signals and speech by electricity, telegraphy, telephony, railways; (*a*) telegraphy, the use of batteries and machines, the best conditions for the establishment of overhead, underground, and submarine lines as regards conductivity and insulation, the use of relays on long lines, lightning conductors on telegraph lines, the advantages and inconveniences of safety wires; (*b*) telephony, the special difficulties encountered in the erection of telephone lines, the cause of disturbing noises; (*c*) railways, application of electricity to ensuring the safety of railways, comparison of automatic and other systems of signalling; (*d*) questions at the discretion of members. Section 3: Industrial applications of electricity; (*a*) electric lighting, the measurement of the luminous intensity derived from electric sources, the various methods of photometry, in default of an absolute unit for measuring luminous intensity, is there any model in existence which can be recommended as an international standard? is it possible to establish simple rules for photometric measures? continuous and alternate current machines, the special conditions in the application of the electric light to the illumination of towns, factories, mines, rooms, light-houses, ships, &c.; (*b*) the transmission of force to a distance by means of electricity, the facts relating to its transmission as at present known, the results that have been achieved and the difficulties to be solved, the utilisation of natural forces by means of electricity, various applications; (*c*) the distribution of electricity for industrial purposes; (*d*) electric clocks, &c., registering apparatus and instruments of precision, its application to geodesy; (*e*) electrometallurgy and the chemical applications of electricity; (*f*) questions at the discretion of members. Third part, public meetings: Amongst the subjects which may be taken up at the public meetings, the Commission calls attention specially to the following:—(*a*) Electrical measures; (*b*) electric lighting; (*c*) transmission of power by electricity; (*d*) telephony and its applications; (*e*) atmospheric electricity, lightning conductors; (*f*) terrestrial magnetism. The programme is dated the 17th August.

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THE ELECTRICAL EXHIBITION AT PARIS.

Miscellaneous Exhibits.

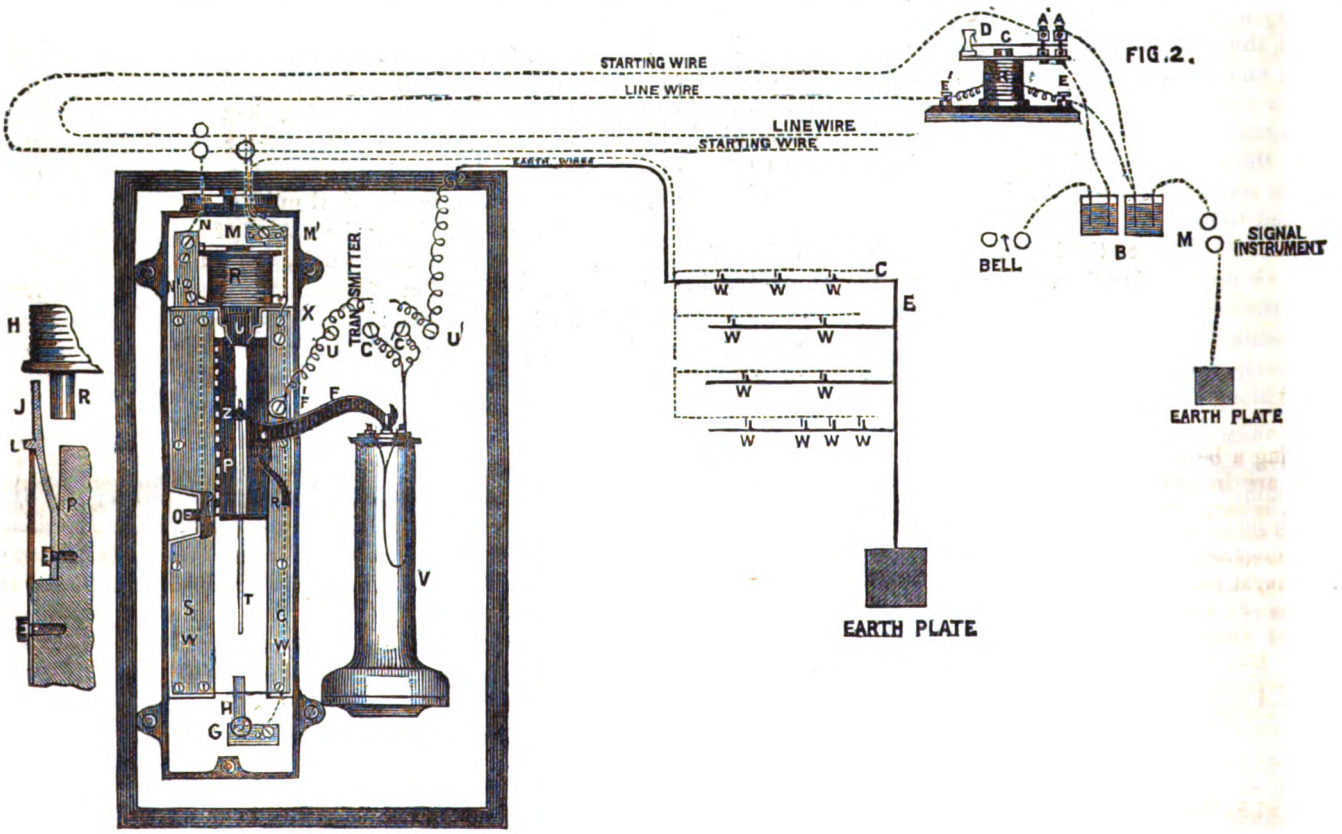
Fire Alarum and Telephonic Signalling Apparatus.

In this system, shown by Mr. Thomas Reid, jun., of Dundee, two wires are carried throughout a district and led into a central station, having no communication with the earth. Any number of signalling apparatus may be joined on to those wires without any additional battery power more than is necessary to work the one farthest away from the station.

In a convenient position outside the buildings is placed the alarum, Fig. 1, from which the wire C is led into all parts of the building; parallel to this is the wire E, leading from telephone stud D to the earth. Communication between these wires can only take place by the heat acting on contacts kept apart by fusible plugs, or contact made by the action of heat on compound metal strip. The time of contact may be regulated to any degree of heat. In Fig. 1 keeping C out of contact with A and A^1 when the current is passing along the line wire; E and E^1, line wire studs for electro-magnet; R, electro-magnet; B, battery; M, Morse instrument and telephone connections.

The current from the battery B passes along the starting wire by means of the spring C in contact with A and A^1, passing down to contact spring N M and M′ along to the successive instruments in circuit. If contact should be made between E and C, the current will pass through electro-magnet R by the terminal X to the plate S and to contact spring H, through G and C to the earth-wire E, the electro-magnet R will break the circuit of all the instruments further away than itself by attracting the contact spring *m*. It also liberates the contact weight P by pulling back the spring catch J and L. In falling it comes in contact with spring O of line wire, the current passes through electro-magnet R to X, and through to O, throwing the starting wire out of circuit by breaking the contact of C with A and A^1, throwing the bell in circuit by contact of C with lower contact studs, the catch D keeping C in contact until removed, the

FIG. I.



THE AUTOMATIC FIRE ALARUM AND TELEPHONIC SIGNALLING APPARATUS.

c and c^1 indicate telephone studs; U and U^1, transmitter studs; X, connection between brassplate S and electro-magnet terminal; Z, pin for lifting contact weight P; P, contact weight, on which are cut notches to make any suitable signal on the Morse system, indicating the locality in which the instrument is placed; O, contact spring for line wire; H, contact spring to earth wire; G, contact stud to earth; C and E, earth wires; T, slot in brassplate for lifting pin travelling; V, telephone; *r*, spring for lifting lever F, in contact with insulated contact stud to earth on the removal of the telephone V; J spring which keeps weight P up by means of the small projection L hanging on plate S, and keeps contact with the plate when the weight falls; *n* and n^1, connections from electro-magnet terminals to starting wire; *m* and m^1, contact spring and stud for completing circuit line of wire; S, insulated plate screwed to the guides W and W.

Fig. 2. A and A^1, contact studs for starting wire; and below, contact studs for bell in station; C, spring for completing circuit between the contact studs; D, catch for makes and breaks of contact-weight P being recorded by Morse recorder or other dot and dash signalling instrument, through which the current passes to the earth. After the signal has been recorded the attendant liberates the catch D, completing the circuit of the starting wire, that instrument being out of circuit with it, owing to the weight having lifted the contact spring H out of contact with the earth stud G. Any other instrument can now signal, but no two instruments can signal at same time.

The telephonic signal acts thus:—The party wishing to communicate with the station lifts the telephone from the lever F, the spring *r* moves the lever F into contact with the stud just above it, completing the circuit of starting wire through electro-magnet R, plate S, along the lever F, and through the contact stud shown, and also U and U^1, to the earth wire E. The weight then falls into contact with the contact spring of line wire O, but cannot go further owing to the end of lever F passing across the slot T. The current then passes along line wire to R, breaks the circuit of starting wire, and rings the bell, also making one dash in Morse recorder. The

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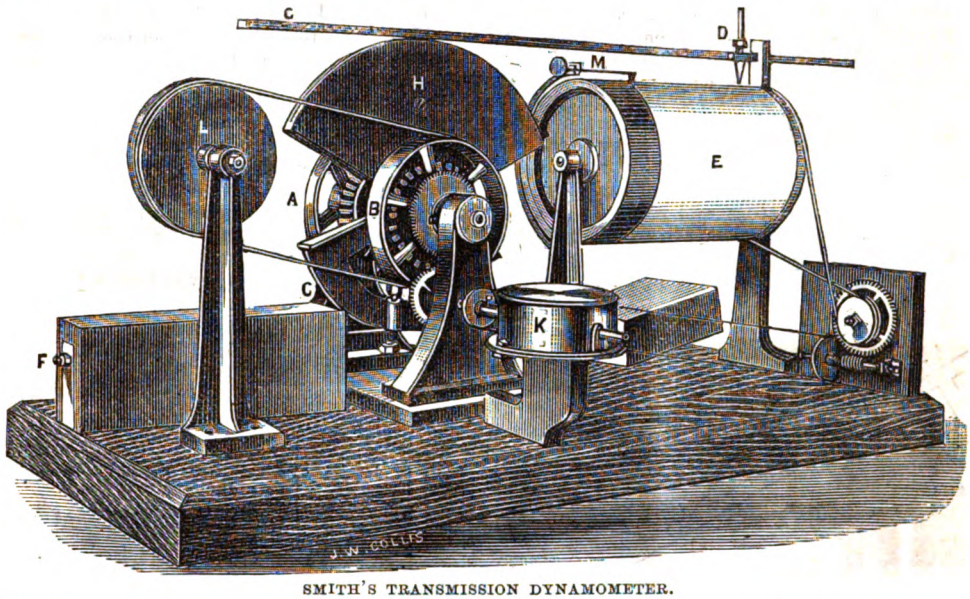
attendant then throws his telephone and transmitter into circuit instead of Morse recorder.

Upon the telephone V being replaced, the lever is moved out of contact with the earth connection, and the weight P is lifted by means of the pin Z, which has been resting on it. It is now in position for further signalling.

Mr. F. J. Smith, of Taunton, exhibits a *transmission dynamometer*. This dynamometer has been designed and constructed to show at any instant, by means of a diagram, the amount of power transmitted in working any machine that may be under trial.

Its construction is as follows:—The two pulleys A B, each carrying a bevil wheel, and running loose on the same fixed shaft, are in gear with a third equal bevil wheel, the axis of which is carried at right angles to the axis of the other two, by the sector-shaped casting C. This sector, while carrying the intermediate wheel, is capable of angular displacement, this displacement being controlled by a spiral spring within the case F, which spring is attached to the sector in such a manner that its pull always acts tangentially to it. An upper sector of wood, H, fixed to the under sector and counterpoised, carries on its edge a light rod, G D, attached to the sector by two cross cords. At D a tracing point records on the drum E an ordinate, which is a measure of the extension of the spring. The drum is driven by a screw and tangent wheel at a given ratio to the speed of the pulleys A or B. The counter K records the number of revolutions. The area of the diagram, when interpreted, shows the amount of force transmitted in any experiment. The inventor states that the areas of diagrams of irregular form are easily estimated by being cut out and weighed, instead of by the usual method of calculation. The wheel and handle L is connected by a belt with the pulley B, to show the mode on which the instrument works. The tension of the belt is indicated by the tracer D. A lever, M, carrying another tracer, and controlled by an electro-magnet in connection with a seconds pendulum, records on the drum the seconds during which any experiment has lasted. In large dynamometers designed by the exhibitor the registering parts are of the same size as those in the instrument shown, the pulleys, bevil wheels, &c., being made of a size suitable for the work for which the instrument is designed. The spiral spring is so placed that its pulling value is in no way affected by centrifugal force. The dynamometer exhibited is suitable for light work, and has been applied to the whirling table and experiments connected with electricity and heat; the large sizes are designed for transmitting 5 and 10 h-p.



SMITH'S TRANSMISSION DYNAMOMETER.

ELECTRIC LIGHTING FOR COAL MINES.*

BY ANDREW JAMIESON.

In the discussion which followed the exhibition of Swan's lamp at the Society of Telegraph Engineers in October last, Professor Tyndall remarked that probably this form of incandescent lamp could be adapted for use in coal mines as a safety lamp. Since then, two practical trials have been made with this object in view—the one at Pleasley Colliery near Nottingham, (June 15 to 18), the other at Earnock Colliery on August 9th and 11th (last). These instalments have created not only a scientific but also a commercial as well as a general and public interest.

The circumstances under which the lighting has to be produced and maintained are new, and different in many respects from that now being carried out above ground in our halls and open spaces. Dangers and difficulties peculiar to the situation have to be guarded against or overcome, such as explosive gases, subsiding of walls or seams, continuous darkness, &c. Long lengths of leading wire have to be dealt with, involving single or double offshoots here and there, requiring considerable mechanical skill and still more electrical knowledge before a suitable distribution of the electric current is effected, and the desired uniformity and intensity of light obtained.

Particular interest is at present being manifested by mine owners, managers, and engineers, to know the commercial value of the light, or in other words, whether the possible increased light and safety of Swan's lamps over the methods hitherto adopted will result in an economy and an increased output of coal for the same expense on labour.

Again, a general and public interest is always awakened in this country when anything is done, or even attempted to be done, for the benefit of our fellow creatures, and more especially when this attempt is directed in aid of our helpless brothers who toil from morning to night, and night to morning, in the ever dark and dismal bowels of the earth, in order to furnish us more fortunate beings with the means of supplying ourselves with coal for our comfort, power, and luxury.

In attempting, therefore, to place before you a few of the leading mechanical and electrical features of the case, I hope to be able to interest you for a few minutes, and to express a desire that the remarks elicited by the discussion may assist materially in promoting and perfecting electric lighting for coal mines.

In the first place I shall review shortly what has been already done at the Pleasley and Earnock Collieries, with an account of the apparatus used, a few of the experiments carried out, and, finally, close my remarks with what appears to me the simplest, most economical, and best means for fitting up a colliery with Swan lamps.

Pleasley Colliery.

In June last Messrs. R. E. Crompton and Co., in conjunction with Swan's Electric Light Company, laid down at Pleasley

* A Paper read before Section G of the British Association, York Meeting, September, 1881.

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Colliery* a temporary arrangement of engine, boiler, dynamo machines, leads, lamps, &c., which they placed at the disposal of the Royal Commissioners for Mines in order to test the suitability of the Swan lamp as a means for lighting up the shaft bottom, roadways, and working faces in coal mines.

Earnock Colliery.

The large drawing on the wall gives a general view of the complete system as carried out at Earnock Colliery, near Glasgow, by Messrs. D. and G. Graham, for Mr. Watson, the proprietor. The enlarged plan is from a scale drawing, kindly furnished to the author by Mr. Gilchrist, manager of the mine.

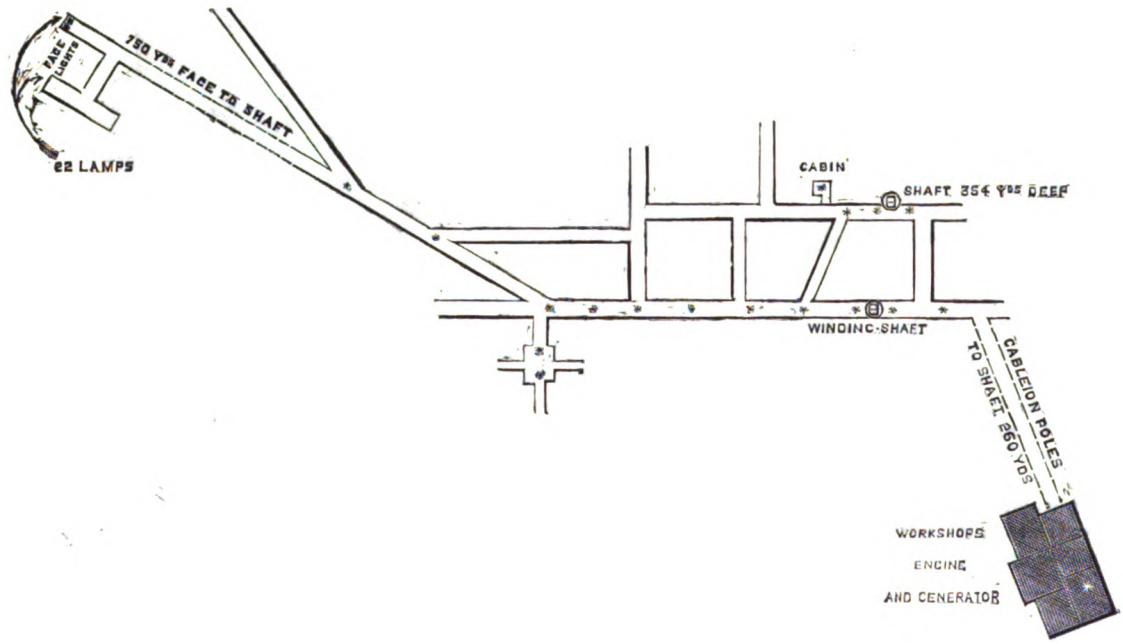
On the right of the diagram, marked "workshops," are placed the engine and generator, about 260 yards from the pit-head. The engine is 12 N. horse-power, constructed by Messrs. Shanks, of Arbroath, having their sensitive governor (about one-third of this power being only required for the present installation). A counter shaft, driven directly by a leather belt from the fly-wheel of the engine, constitutes the intermediate means by which the speed is increased for driving an "A" Gramme dynamo generator. The two main leading wires from the dynamo machine, are led up through the roof, and fixed to two bare copper ropes respectively $\frac{3}{8}$ of an inch in diameter. These copper conductors are carried on poles to the pithead, and insulated at the supports by means of ordinary porcelain insulators and vulcanised india rubber, and thereafter continued down the shaft to the pit-bottom, a further distance of 354 yards, by two leading wires, consisting of a copper strand insulated with gutta percha, taped and tarred, the whole being enclosed in a galvanised iron tube. The same description and size of main leading wire is used along the whole distance of the seam to two working faces, a complete distance of 750 yards from the pit-bottom, making the entire distance from the generator to the extreme lamp 1,564 yards, or say 3,128 yards of main leading wire. At each of the twenty-two positions shown in the figure is joined up by branch leads a Swan lamp, encased in a suitable lantern, sixteen of these being fixed lamps, and six portable. The lanterns containing Swan's lamps were described, they were made from the design of Messrs. D. and G. Graham. Each of the twenty-two lamps was provided with an air-tight gravity mercurial contact for the purpose of switching on and off the current. They were peculiar in this respect, that upon cutting a lamp out of circuit they bring into circuit a wire resistance equivalent to that of the lamp. The primary object of these air-tight contact makers or switches is to prevent the spark which is inevitably generated when opening an electric circuit from communicating with and exploding the gas in a fiery mine. Several forms of such air-tight contact makers have been designed by the author in order to prevent making a spark when joining up a lamp or lead.

The principle upon which the lamps were arranged was that of "parallel circuit." This system of joining up the lamps is neither the best nor the most economical that can be arranged. It necessitates their being of nearly uniform resistance, or of slightly decreasing resistance in proportion to their distance along the main leads, in order that the current may be uniformly distributed among the lamps, and thus give to each lamp the same illuminating power.

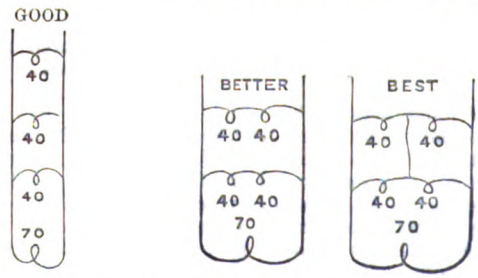
It may not be out of place here to mention that a good Swan lamp has a resistance when incandescent (at 20 candle-power), of 30 ohms, with an E.M.F. or a difference of potential on its terminals of 45 volts, and therefore a current of 1·5 weber passing through it. This is slightly over 220 candles per h.-p. absorbed by the lamp. The author has ascertained by actual tests carried out by himself in Glasgow, from a mean of several lamps tested, that :—

Res. in ohms (hot)	E.M.F. (volts)	Current (webers)	Candle power	Candles per h.-p.	H.-P. per lamp
25	43	1·7	18	175	·1

Of course it must be clearly borne in mind that the higher the candle-power at which the lamps are worked the greater the (horse-power) economy. If a Swan lamp were raised to a temperature sufficient to give 600 candles, then we should have about 1,200 candles per horse-power. On an average we may consider it a safe statement that ten Swan lamps absorb one horse-power. This does not take into consideration the fact that a certain amount of power is absorbed in the engine, generator, leads, &c., and in making an installation of say fifty Swan lamps we may reckon 30 per cent. at least of the power as lost in the manner indicated; which leaves seven lamps per indicated horse-power, or it will require seven indicated horse-power for fifty lamps giving eighteen candle-power each.



It is important to note that the system adopted at Earnock Colliery is far from being the best for Swan's lamps, in as far as the self-exciting Gramme machine does not readily admit of any automatic current regulation. For example, if under ordinary circumstances we have twenty-two lamps in action, and it be desired to suddenly cut out any number of these, say ten or twelve, the immediate effect will be that of overstraining the remaining lamp by excessive current. At Earnock Colliery, however, an attempt has been made to avoid this danger by causing any switch to introduce a resistance equivalent to that of the lamp which it cuts out. It will at once be seen that this is an uneconomical expedient, because the resistance thus introduced



* See *Electrician*, Vol. VII., No. 6, pp. 84 and 88.

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absorbs power equal to that previously absorbed by the lamp now cut out. If a Siemens alternate current machine (with separate exciter for magnets) be used, then the E.M.F. remains practically constant whatever change is made in the number of lamps in circuit, and thus without any direct current regulator the lamps are never endangered.

The explanation of the fact is as follows, if the conditions are observed:—

Let C = the current in webers.
E = the electromotive force. Generated by the Siemens machine at a certain velocity *this is a constant quantity.*

$$R = G + L + \frac{S}{n}$$

G = resistance in ohms of the generator coil.
L = resistance of leading wires.
S = resistance absolute of Swan's lamps, each parallel.
n = number of lamps in circuit.

Then, by Ohm's law,

$$C = \frac{E}{R} = \frac{E}{G + L + \frac{S}{n}}.$$

If (G + L) be very small, compared to $\frac{S}{n}$, then practically

$$C = \frac{E}{\frac{S}{n}} = \frac{nE}{S}.$$

If we halve the number of lamps, then the total current generated by the machine is halved, for

$$C = \frac{nE}{2S}.$$

With still the same current through each lamp, again, if we have only $\frac{1}{10}$ or $\frac{1}{n}$, then the same takes place,

$$C = \frac{nE}{10\,S}, \text{ or } = C = \frac{nE}{nS} = \frac{E}{S}.$$

This is a very great improvement upon the self-exciting Gramme or Siemens machine, and entirely does away with the necessity for a specially constructed system of automatic current regulator. It, therefore, simplifies the mechanical arrangements, and does away with the danger and inconveniences arising from turning off or putting on a number of lamps (within the limits of the machine).

These alternate current machines of Siemens also admit of burning an arc light in conjunction with and fed from the same machine as the Swan incandescent lamps; this is advantageous for surface lighting.

I cannot do better than indicate how I would propose to carry out a system of electric lighting for colliery purposes than by reviewing what I have purposed with Mr. Swan's concurrence and approval for Eppleton and Houghton pits, near Hetton, Durham.

1. The motive power to be Marshall and Sons best made horizontal engines, with their specially constructed automatic governor.
2. Siemens's exciter and alternate current machines.
3. Leading wire by Silvertown India Rubber and Gutta Percha Company, No. 1,092, having resistance of less than ¼ ohm per 1,000 yards.
4. Swan's lamps encased in specially designed strong lanterns. Those that are fixed to have hemispherical glass globes and copper silvered reflectors, suited for projecting the light downwards or along the gallery or seam as desired; and those that are movable to be placed in lanterns like one or other of those before you, only lighter and more handy, specially strong 100 candle-power Swan lamps being provided for the screens and other places where a strong light is desired.
5. For the open space surface works, and where the railway and surface haulage takes place, Siemens's (alternate current) arc lights are proposed, suitably placed to admit of working at night with a readiness and celerity almost equal to that in the day time.
6. Ayrton and Perry's electro dynamometers for measuring the strength of the electric current.
7. Velocimeter, switches &c., as per specification.

The complete specification and estimate is drawn up with a view of entirely superseding gas and oil on the surface works, the three coal seams, and for stables and haulage near shaft, but not to be continued to the front at present, the distance being very great (2 to 3 miles).

Finally, I would remark that, if any coal mine owner or company desire to have a proper and complete understanding as to the probable cost and efficiency of this new system of lighting coal mines, they should apply direct to the head-quarters of Mr. Swan's company, or employ a qualified electrician to draw up the specification, &c.

[In the discussion Mr. R. E. Crompton strongly combated some of the statements made in this paper, more especially with regard to the self-exciting Gramme, and to automatic regulators.]

MINING LAMPS, &c.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: We observe from description of mining lanterns and circuit closers for electric light purposes given by Mr. Jamieson in your paper that he takes the credit of the designs or inventions of those used at Earnock to himself, and that ours is simply a modification of his. In contradicting this we beg to state that the lantern designed and made by us was finished and out of the workmen's hands before Mr. Jamieson even sent us the drawing of his lantern. Regarding the circuit closers, we had not seen nor heard of his until ours were in actual operation. We expect to be able to send you drawings and full particulars of our apparatus shortly. Meantime we shall feel obliged by your inserting this note.—Yours, &c.,

D. and G. GRAHAM.

Glasgow, September 7, 1881.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your issue of August 20th, p. 218, where you are good enough not only to give woodcuts but a full explanation of my miner's lantern, as shown by Mr. Swan at the Paris Electrical Exhibition, it is stated that "the actual lantern employed in this application at Earnock Colliery is a modification of the Swan lamp designed by Mr. A. Jamieson, Glasgow," &c. Now in order that there may be no mistake I beg to state that the "*actual lanterns*" had the "bayonet" fastening to keep the upper and lower parts together, a modification by Mr. David Graham; while mine, as made by his firm, had a clip fastening similar to that in Silber's well-known lamp. In every other respect I believe they are practically similar, except in size, mine being about one half the weight and size of the other. The wire gauze was an afterthought, and need only be put on in a fiery mine, as of course it would considerably reduce the light. All plans, as yet, are merely modifications of Mr. Swan's original design.—Yours, &c.,

ANDREW JAMIESON.

College of Science and Arts, Glasgow,
August 31st, 1881.

TO CORRESPONDENTS.—Owing to the pressure on our space, we are compelled to hold over several letters for a future issue.

TELEGRAPH POLES WANTED.—The Postmaster-General is inviting tenders for the supply of telegraph poles as follows:—10,775 red fir telegraph poles, to be delivered in London; 15,539 (minimum) or 26,886 (maximum), to be delivered at any one of the ports on the East Coast between the Humber and the Tyne, both inclusive; 4,833 to be delivered at Perth; and 6,514 to be delivered at Dublin. The poles to be felled between 1st November, 1881, and the 28th February, 1882, and to be delivered during the following summer. Tenders are also invited for creosoting the above-mentioned poles with either 8lb. or 10lb. of creosote to the cubic foot, as may be decided. Tenders may be submitted either for (A) supply of the poles only, (B) both supplying and creosoting, or (C) creosoting only; but, if B be tendered for, tenders for A and C are also requested. Forms of tender, containing all particulars, may be obtained on application, either personally or by letter, to Mr. W. H. Winter, Controller of Stores, Telegraph-street, Moorgate-street, E.C. The tenders must be sent in by noon on Monday, the 17th of October.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

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TECHNOLOGICAL EXAMINATIONS, 1881.

The results of the third examination in technology, under the direction of the City and Guilds of London Institute, are now before us, and we are able to judge of the progress technical education has made under its auspices during the past three years. It is far too soon yet to predict what may be the effect of this branch of education upon the classes for whom it is intended, or upon the industries in which they are engaged; but this much is already certain, that the interest taken in it is widely extending, and the area of tuition rapidly enlarging. Not only are the subjects of examination, and, presumably, of instruction, more numerous this year, but the number of towns supplying candidates have greatly increased. The examination papers, too, have given greater satisfaction than in either of the two preceding years, the growth in the number of successful competitors bearing, as it should do, a constantly increasing ratio to the number of persons examined. The City of London has, therefore, to be congratulated upon the first fruits of its generous and enlightened policy—fruits which will ripen and yield a bountiful harvest, we have no doubt, in the not far distant future.

One thing, however, we should have liked to be sure about, namely, that these technical classes are educating chiefly the persons for whose benefit they were organised; and we think it a pity no information is forthcoming in the report on this important point. The committee are, no doubt, sufficiently alive to the true aim of their educational scheme to notice any shortcomings in this respect; and we are willing to believe, as no mention is made to the contrary, that the major portion of the candidates belong to the artisan classes. Some statistics on this matter another year would be very acceptable. Except as a means of obtaining a higher class of candidates who propose to become teachers we do not see the object of certain alterations in respect to "honours" examinations; for, in our view, a candidate already possessing two advanced certificates from the Science and Art Department is not exactly the sort of person contemplated as coming within the operations of this Institute. Some exception may also be taken on similar grounds to an ambitious programme, grouping several electrical subjects under the heading of "Electrical Engineering." Amongst these we notice the "Transmission of Electrical Energy." This can hardly yet be called an industry, and it is somewhat premature to connect it, even remotely, with any existing art or manufacture. A subject of the highest importance it undoubtedly is; but its practical utility to the working man is by no means apparent yet awhile. On the other hand, a radical change in the grades of examination will, probably, work well in the direction we desiderate, if the examiners frame their papers judiciously. There is to be no "Advanced" grade, and an "Ordinary or Pass" grade is substituted for what was formerly the "Elementary" grade. Various reasons are assigned for this alteration; but it is sufficient to note that the division of the examination into two stages corresponds best with the classes of candidates who compete.

Turning to the results of the examination for the past year, especially to those chiefly interesting to the readers of this journal, we are struck by the paucity of candidates in the subjects of Telegraphy and Electro-metallurgy. Considering the extent and importance of the industrial arts directly associated with the last-named science, it is perfectly inexplicable that the candidates who offered themselves for examination in it numbered only four. In Telegraphy, also, 99 students is a surprisingly poor muster. With the special advantages telegraphists possess in being in daily contact with both the practical and theoretical side of their profession, their chances of success, one would have thought, would tempt them to compete in large numbers. This is evidently not the case, however, and inasmuch as it points to the fact that the telegraphists as a body do not attend science classes connected with their own vocation it is much to be regretted. Possibly the telegraphist thinks he knows quite enough about telegraphy already, and has more than enough of it in the way of business without paying court to it in his hours of leisure. But this is precisely a view of which his employers should take pains to disabuse him. In other words, they should make it worth his while, or show that it is likely to be worth his while, to devote some study to the technical part of his business. Of this, however, we are sorry to say we can discover no evidence whatever. Of the 99 candidates who offered themselves it appears from the examiners' report many were not telegraphists, and from the whole number only 49 could be selected as fit to pass. More than half of these passed only in the lower class of the elementary grade, and only 28 out of the 49 seem to have previously undergone any regular course of study in classes.

A glance at the "Pass List," showing the places at which the successful telegraph candidates were located, reveals another fact equally discouraging. One would expect that the majority would hail from towns at which the largest

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telegraph centres are situated; but this is not the case. Such comparatively obscure places as Rochdale, Rugby, Shrewsbury, Belfast, Sunderland, Hull, Dundee, Devonport, yield their ones and twos and threes, whilst Nottingham has the honour of taking four certificates and a prize. Newcastle-on-Tyne, by no means a station of first rank, but always famed for the excellence of its staff, carries off the palm with no fewer than nine certificates, of which five are in the advanced grade. Bradford comes next with a roll of five, including a £3 prize. On the other hand, Liverpool can only boast of one, and Glasgow of no more, though its one representative carries off a prize. Birmingham supplied no successful candidates. Manchester is credited with five elementary certificates and two advanced—a by no means wonderful achievement considering the amount of eligible material existing at that place. But it is highly meritorious when compared with the net takings of its rival in the metropolis. We are not told how many candidates offered themselves in London; but either they were very few or they were very ill-advised. Possibly they flew too high; but more probably, we fear, they did not fly at all. A second class in honours, and a prize in advanced, is all that the world's greatest telegraphic centre has to show as evidence of the competency its servants display in the technicalities of their profession. Comment is needless.

There is no ground for supposing, however, that the case of the telegraphists is typical. There may be special reasons to account for their lukewarmness which do not prevail in other callings. Taken as a whole, indeed, the report is most encouraging, and we are glad to see that not only are the promoters determined to persevere, but that their enterprise shows promise of being crowned with well-deserved success.

INTERIM REPORT OF THE ELECTRICAL STANDARDS COMMITTEE.*

The committee consisted of Professor G. Carey Foster, Mr. C. Hockin, Professor Sir William Thomson, Professor Ayrton, Mr. J. Perry, Professor W. G. Adams, Lord Rayleigh, Professor F. Jenkin, Dr. O. J. Lodge, Dr. John Hopkinson, Dr. Muirhead, Mr. W. H. Preece, and Mr. Herbert Taylor.

It appeared to the committee that, in order to perform the task entrusted to them, they had two principal questions to consider:—First, to select or prepare a well-defined standard of accurately-known absolute value for each kind of magnitude; and, secondly, to take measures for making certified copies of each of the adopted standards accessible to the public.

The standard magnitudes which the committee have had under consideration as yet are—

(1) The Standard of Resistance,
(2) The Standard of Capacity,
(3) The Standard of Electromotive Force.

As to the first of these—the standard of *resistance*—the committee were of opinion that, in view of the discrepant results obtained by experimenters who have re-examined the absolute resistance of the B A unit, it might be well to reconsider the question whether the "ohm" should be defined by reference to a particular coil of wire preserved as a concrete standard, or whether the term "ohm" should be understood to mean a resistance of 10^9 C.-G.-S. units. They were also of opinion that it was desirable to continue the experimental investigation of the absolute resistance of the existing standards.

The repetition of the determination with the original apparatus by Lord Rayleigh and Dr. Schuster, in the Cavendish Laboratory, has gone far to supply this requirement. Experiments by another method have also been carried on by Professor G. C. Foster in the Physical Laboratory of University College, London. Some account of these experiments is given in an appendix to this report, but the results hitherto obtained can only be regarded as preliminary. With regard to the issue of authorised copies of the ohm for general use, the committee did not see their way to making arrangements for actual construction of standard coils. They were of opinion that it would be best to limit this action to drawing up a detailed specification for the construction of standard resistance-coils, and to arranging for the systematic testing of coils which are certified to them as being made in accordance with this specification, issuing certificates showing their actual resistance. Such a system would be analogous to the system adopted by the Kew Committee for the testing of meteorological instruments at the Kew Observatory. It has not yet been settled by whom this duty should be undertaken.

With regard to standards of *capacity*, the committee are able, thanks to the zealous co-operation of one of their number, to report somewhat more complete arrangements, Dr. Muirhead having undertaken for the present to make and issue standard condensers, adjusted in accordance with one of whose absolute capacity has been determined by himself and Mr. Hockin (*British Association Report*). With a view to testing the permanency of condensers made with mica, paraffined paper, or other solid insulators, Dr. Muirhead is also having constructed a large air-condenser.

In reference to the standard of *electromotive force*, the committee have had to consider whether this ought to be based upon a particular combination of chemicals forming a galvanic cell of definite electromotive force, such, for instance, as a Daniell cell constructed in a specified manner from materials of guaranteed purity, or the cell introduced by Mr. Latimer Clark *(standard cell)*, or whether they should not rather aim at the construction of some convenient form of electrometer capable of indicating with sufficient accuracy an electromotive force of about a volt. The first plan would be comparable with a supply of ice and boiling water as affording a standard interval of temperature; the second would be comparable with a thermometer showing the two limits of the standard interval. The committee are not yet prepared to make a final recommendation as to either method of embodying the standard electromotive force, though they are strongly inclined to believe that an electrometer, or gauge, capable of showing when a definite electromotive force has been developed, by whatever means, will ultimately be found more satisfactory than any system in which the constancy of an electromotive force is inferred from the supposed constancy of the conditions under which it has been developed.

Another question of a more general kind, which, though it may not be of much immediate practical importance, will eventually have to be carefully considered, has occupied the attention of the committee to some extent. It is the question as to what concrete standards should finally be recognised as fundamental standards. Supposing that we already had independent standards of *Resistance*, *Capacity*, *Electromotive Force*, *Quantity*, and *Current Strength*, each of them defined with all the accuracy that our present experimental methods admit of, they would infallibly be found to exhibit small discrepancies when compared together. For instance, the current of standard strength would not be exactly the same as that produced by the standard electromotive force acting in a circuit of the standard resistance, and we should then have to consider which of the three standards was to be corrected, so as to bring it into harmony with the other two.

Similarly, in the case of the other electrical magnitudes, the known relation between these are sufficient to enable us to define the unit of any one of the five magnitudes just mentioned in terms of the units of any two of the rest. Hence it appears that the electrical standards of ultimate authority cannot be more than two in number, and it will have to be decided which pair of concrete standards are to be recognised as ultimate or fundamental, and what are to be left to be defined by reference to these.

A further question arising out of the mutual relations of the fundamental units was that of the magnitude of the practical units to which distinctive names should be attached. The present usage with respect to this matter is that a *resistance* of 10^9 C.-G.-S. units is called an *ohm*, an *electromotive force* of 10^8 C.-G.-S. units is called a *volt*, and the current produced by a volt acting through an ohm., that is to say, a current of $10^8 \div 10^9$, or 0·1 C.-G.-S. unit, is called a *weber*. In the opinion of the committee it was considered highly desirable, from a scientific point of view, that the relations among these standards should be simplified by defining them as follows:—

Ohm = 10^9 C.-G.-S. units of resistance.
Volt = 10^8 C.-G.-S. units of electromotive force.
Weber = 1 C.-G.-S. unit of current.

It was felt, however, that any recommendation of the value

* [We are, by the courtesy of Professor Foster, F.R.S., enabled to give in full the report of the British Association Committee on Electrical Standards, which will be found of great interest when the questions to be discussed at the forthcoming Paris Congress are considered. Appendix No. II., dealing with the question of the use of Platinum-silver or German-silver in coils, will be given in our next issue.—Ed. *E.*]

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attached to terms which are rapidly coming into extensive use among practical electricians might give rise to serious inconvenience. Therefore, although with regard to the scientific aspect of this proposal the committee were decidedly in favour of the change, they felt that a public recommendation could not well be made until the practical inconveniences likely to follow had been very carefully investigated.

Appendix I.

Account of preliminary experiments on the Determination of Electrical Resistances in Absolute Measure.

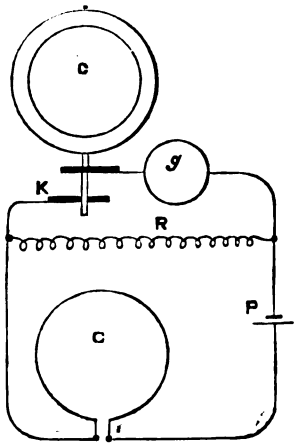
By Professor G. Carey Foster, F.R.S.

The experiments to be described in what follows were made in the Physical Laboratory of University College, London. The principle of the method employed is essentially the same as that of the method long ago pointed out by Sir William Thomson, and adopted by the first Committee of this Association upon Electrical Standards in their experiments of 1863 and 1864, as well as by Lord Rayleigh in the repetition of the experiments recently carried out by him in conjunction with Professor Schuster.

Every absolute measurement of resistance is, by the nature of the case, fundamentally the determination of the ratio of an electromotive force to the strength of the current which it produces in the conductor whose resistance is to be measured. In Sir William Thomson's method, as is well known, the electromotive force is due to the action of the earth's magnetism upon a coil of wire spinning about a vertical diameter, and its numerical value is known from the rate at which the coil spins, the total area enclosed by its windings, and the intensity of the horizontal component of the earth's magnetism. This electromotive force generates a current in the coil the strength of which is known from the deflection of a small magnet hung at the centre of the coil, and from the intensity of the earth's horizontal magnetic force. This last factor, entering similarly into the expressions for the electromotive force and for the current, disappears from their ratio, which gives in absolute measure the resistance of the wire forming the revolving coil.

In the method now to be described there is again an electromotive force generated in a revolving coil, just as in Sir William Thomson's method, but the current is measured by an independent galvanometer, and the conductor whose resistance is given by the experiments is entirely distinct from the revolving coil. So far as this method possesses any particular advantages these arise from the circumstance last mentioned. The conductor of which the resistance is measured being at rest, it may be a coil of wire of any material, wound in whatever way may be most convenient, and it may be immersed in a bath of liquid, so as to keep it at an accurately-known temperature. Moreover, several independent coils of different resistances can be experimented upon one after another, and the resistance of each determined.

The nature of the method and the arrangement of the essential parts of the apparatus may be explained by help of the adjoining figure. In this R stands for the *wire*, of which the resistance is



to be measured, and P for a *thermopile*, whereby a current is produced through R and through a *tangent-galvanometer*, G. The ends of the wire of the revolving coil C are connected through a commutator, K, upon the axle with the ends of the wire R, a delicate reflecting galvanometer, *g*, called in what follows the *zero-galvanometer*, being interposed on one side of the commutator. When the speed of the coil is so adjusted that the zero-galvanometer is not deflected the electromotive force developed in the coil by the magnetism of the earth is equal to the electromotive force exerted by the thermopile between the ends of the conductor R. Consequently, the resistance of this conductor is obtained in absolute measure by dividing the electromotive force of the coil by the strength of the current indicated by the tangent-galvanometer.

This result may be expressed in terms of the experimental data, as follows:—Let A be the total area included by all the convolutions of the revolving coil, that is the sum of the areas included by all the turns taken severally, H_c the horizontal magnetic intensity at the place occupied by the coil, ω the angular velocity of the coil, and $2a$ the arc of contact made by the commutator, then E, the electromotive force of the coil, is

$$E = A H_c \omega \frac{\sin. a}{a}.$$

Again, if Γ is the strength of the magnetic field produced at the centre of the tangent-galvanometer, when the needle is hung, by a current of unit strength flowing through the galvanometer, H_g, the horizontal intensity of the earth's megnetic field at the same point, and θ the deflection of the galvanometer, the strength C of the current in the galvanometer, and, therefore, also in the wire R, is

$$C = \frac{H_g}{\Gamma} \tan. \theta.$$

Hence, putting ρ for the resistance to be measured, that of the wire R, we have

$$\rho = \frac{E}{C} = \frac{H_c A \omega \frac{\sin. a}{a}}{H_g \Gamma \tan. \theta},$$

$$\text{or} \quad \rho = \frac{H_c}{H_g} \cdot \frac{2\pi A \frac{\sin. a}{a}}{\Gamma T \tan. \theta},$$

if T is the period of one revolution of the coil.

If the experiment could be made in a region of uniform magnetic force, we should have $H_c = H_g$, and, therefore, the ratio $\frac{H_c}{H_g} = 1$, as in Sir William Thomson's method. Owing to the neighbourhood of rather large masses of iron this condition was not fulfilled in the actual experiments. The ratio in question was accordingly determined by noting the time of vibration of the same magnet, when it was suspended alternately in the position of the revolving coil and in that of the galvanometer respectively. It was thus found at the beginning of the experiments that $\frac{H_c}{H_g}$ was equal to 0·9889. A repetition of the measurement that was afterwards attempted was made useless by some large masses of iron being brought just outside the laboratory while it was going on.

The ring upon which the revolving coil was wound, as well as the frame in which it was mounted, were in the main copied from those used in the experiments of the former committee, but both ring and frame were made considerably stouter in the metal, and the ring had only one groove instead of two. The upper and lower halves were insulated from each other, to prevent the formation of induced currents.

To determine the area A, we have $A = \frac{n\ m^2}{4\ \pi}$, where n is the number of turns of wire on the coil and m the circumference of the mean layer. The value of m was ascertained by measuring with a steel tape the circumference of the groove in which the coil was wound as well as the circumference after each successive layer of wire had been put on. The mean of all these measures, corrected for the thickness of the tape, about 0·01 cm., was taken as the value of m. In order to guard against accidental error, the separate measurements of the circumference were combined in pairs, thus, $m_0 + m_n, m_1, + m_{n-1}$, ... the suffixes denoting the number of layers of wire wrapped on when the measurement was made. These sums, which ought to be constant, varied between 193·25 cm. and 193·50 cm., the number of layers being 32. In this way the circumference of the mean layer was found to be 96·669 cm., which gives for the area enclosed by it 743·64 sq. cm. Each layer of wire contained 30 turns, and therefore $n = 30 \times 32 = 960$, and the total effective area of the coil was $A = 960 \times 743·65 = 713.904$ sq. cm.

The tangent-galvanometer had two equal parallel coils of approximately square section placed at a distance apart nearly equal to their mean radius, which was about 18·25 cm. Each coil consisted of 22 layers of 20 turns each; the galvanometer had thus altogether 880 turns of wire. The needle consisted of three short bits of hardened and magnetised watch-spring fastened one above another at the back of a light plate glass mirror. The deflections were read upon a straight glass scale

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divided at the back into millimetres. The distance from mirror to scale was 128·05 cm., of which about 0·3 cm. was occupied by glass; the optical distance was therefore taken as 127·85 cm. The galvanometer-constant Γ was calculated by the formula

$$\Gamma = n' \cdot 4\pi \left(b_1 \log_e \frac{a_1 + \sqrt{a_1^2 + b_1^2}}{a_2 + \sqrt{a_2^2 + b_1^2}} - b_2 \log_e \frac{a_1 + \sqrt{a_1^2 + b_2^2}}{a_2 + \sqrt{a_2^2 + b_2^2}} \right),$$

where n' is the number of turns of wire (880) in the two rings taken together, a_1 the external radius of each coil, a_2 the internal radius, b_1 the half-distance measured parallel to the axis between the outer surface of the coils, and b_2 the half-distance between their inner surfaces. The numerical value of Γ was found to be $\frac{1}{0{\cdot}004611}$, so that the absolute strength of a current measured upon this galvanometer is

$$0{\cdot}004611\ \mathrm{H} \tan. \theta.$$

The commutator of the revolving coil consisted of a cylindrical piece of ivory about 7·6 cm. in diameter with two pieces of platinum let in upon opposite sides. One end of the wire was fastened to one of these platinum pieces, and the other end to the other piece, and contact with the external circuit was made through two platinum-faced gun-metal wheels, each about 15 cm. diameter, which revolved in contact with the ivory cylinder. The wheels revolved in insulated bearings about vertical axes, nearly in the same plane as the axis of rotation of the coil. The upper end of the axle of each wheel carried a small copper mercury cup into which a well amalgamated copper wire dipped for connecting the coil with the ends of the wire R (see figure) of which the resistance was to be measured. In order to avoid as far as possible the effects of self-induction in the revolving coil, the platinum contact pieces had an angular breadth of only about 20 degrees, so that the coil was in metallic connection with the rest of the circuit during only about 1-9th of each revolution. By adjusting the contact wheels so that the vertical plane containing their axes coincided with the magnetic meridian, the middle of the period of contact was made to coincide with the instant of maximum intensity and minimum rate of variation of the electromotive force in the coil. The arc of contact actually employed was 20° 3′, which gives for the ratio of the maximum and minimum electromotive force due to the earth's magnetism the value 1:0·9847, or an extreme variation of scarcely more than 1·5 per cent.

Putting together the values of the constant factors in the expression for the resistance to be determined, we get

$$\rho = \frac{9{\cdot}5743 \times 10^8}{\mathrm{T} \tan. \theta},$$

leaving T, the period of rotation of the coil, and θ, the deflection of the tangent-galvanometer, to be observed in each experiment.

To determine the speed of the coil the following method was adopted. Three glass pens, each controlled by a small electro-magnet, were caused to mark side by side upon a strip of paper drawn forward by clockwork as in an ordinary Morse receiver. The pens, when left to themselves, ruled parallel straight lines on the paper, but when any of the electro-magnets were excited the corresponding pen was pulled to one side, and a notch was made in the line the pen was drawing. By means of a wheel of 100 teeth, carrying a pin which made contact with a light spring once in every revolution, and gearing into a screw cut upon the upper part of the axle of the coil, the circuit of one of the electro-magnets was completed for an instant at every hundredth revolution of the coil, and an indentation was made in the corresponding line. The circuit of the second electro-magnet was broken for an instant by a clock at intervals of one second, thus making notches on the second line. By afterwards measuring the distances between the notches on the two lines, the speed with which the coil was spinning at any instant could be ascertained. This measurement was made by laying over the paper a strip of glass divided on its lower surface into centimetres and millimetres. The degree of accuracy attainable in this way, independently of error of the clock, was about one part in one thousand. The electro-magnet acting on the third pen was under the control of an observer, who watched the zero-galvanometer (g in the figure) and held down a contact-key, which completed the corresponding circuit whenever and as long as this galvanometer showed no deflection. In this way the third line on the recording strip was displaced to one side whenever the speed was such as to cause the electromotive force of the coil and that due to the thermo-electric pile accurately to balance each other, and thus the parts which were to be measured of the other two lines were indicated. A second observer noted the reading of the tangent-galvanometer when the zero-galvanometer was undeflected and thus determined the angle θ. It is evident, from the formula given above, that the product T tan θ should be constant in all experiments in which the wire whose resistance was to be determined was the same. The amount of agreement in the value of this product in different experiments, therefore, affords a criterion of the consistency of the results with each other. The results obtained in two series of experiments were as follows:—

T tan θ. (Series I.)	T tan θ. (Series II.)
0·01290	0·01192
·01295	·01196
·01308	·01193
·01311	·01195
·01308	·01188
·01282	·01191
·01297	·01192
·01305	·01194
·01294	—
·01306	—
·01301	—
·01293	—
·01309	—

It will be seen that the second set of values agree better together than the first set. This is probably chiefly due to greater practice in observing and to the adoption of an artifice whereby the speed of the gas engine employed to drive the coil was kept more constant. In calculating the final result from each set, weight was given to each separate observation in proportion to the square of the number of revolutions of the coil over which it extended; for it was assumed that the accuracy with which the speed of the coil was determined was proportional to the number of revolutions included in the record; moreover, the number of galvanometer readings obtained in each experiment was proportional also to the number of revolutions, and hence it was assumed that the accuracy with which the product was determined was proportional to the square of the number of revolutions. The weighted means thus calculated are, for the

First Series..... 0·013009
Second Series ..... ·011915

calling ρ_1 and ρ_2 the resistances measured in the two series of experiments respectively, these results give

$$\rho_1 = \frac{9{\cdot}5743}{{\cdot}013009} \times 10^8 = 73{\cdot}598 \times 10^9,$$

and

$$\rho_2 = \frac{9{\cdot}5743}{{\cdot}011915} \times 10^8 = 80{\cdot}355 \times 10^9.$$

The wires measured belonged to a set of German silver resistance coils which were very carefully adjusted by my assistant, Mr. W. Grant, by comparison with a "B.A. unit" coil issued by the former committee. The nominal values were 73 and 80 ohms in the two sets of experiments respectively. Applying a not very certain correction for the difference between the temperature of the coils during these experiments and that at which they were adjusted, we get for the nominal values

$$\rho_1 = 73{\cdot}16 \text{ ohms},$$

and

$$\rho_2 = 80{\cdot}18 \text{ ohms},$$

Hence, according to the *first* series of experiments,

$$1 \text{ ohm} = \frac{73{\cdot}598}{73{\cdot}16} \times 10^9 = 1{\cdot}0060 \times 10^9.$$

According to the *second* series,

$$1 \text{ ohm} = \frac{80{\cdot}355}{80{\cdot}18} \times 10^9 = 1{\cdot}0022 \times 10^9.$$

I do not attach any particular importance to these values, as the experiments so far have only been undertaken with the view of ascertaining how far the method that has been described was capable, when employed under favourable circumstances, of giving good results. In this respect I think the experiments may be considered fairly satisfactory, but the numbers obtained for the value of the ohm are subject to several corrections, the most important of which are probably that for errors of the clock, which I had no means of rating more accurately than by comparison with a good watch; that due to slight uncertainty as to the value in ohms of the resistances measured; that due to self-induction in the revolving coil, which, however, I believe must be very small; and perhaps errors due to unobserved disturbances of the magnetic field during the experiments.

I wish in conclusion to acknowledge with warm thanks the obligations I am under to Mr. Charles Hockin for most valuable aid of various kinds, important practical suggestions as to the construction of the apparatus, information as to the conditions required in order to ensure sensitiveness, and the loan for a long time of a very delicate zero-galvanometer, and a set of resistance coils. I am also greatly indebted to Mr. Grant and Mr. G. W. von Tunzelmann, B. Sc., by whom conjointly the actual observations were almost entirely made.

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THE BRITISH ASSOCIATION.

MATHEMATICAL SECTION.

Sir WILLIAM THOMSON, F.R.S., Professor of Natural Philosophy in the University of Glasgow, President of the Mathematical and Physical Science Section, delivered an opening address on the sources of energy in nature available to man for the production of mechanical effect, as follows:—During the fifty years' life of the British Association, the advancement of science for which it has lived and worked so well has not been more marked in any department than in one which belongs very decidedly to the Mathematical and Physical Section—the science of energy. The very name "energy," though first used in its present sense by Dr. Thomas Young about the beginning of this century, only came into use practically after the doctrine which defines it had, during the first half of the British Association's life, been raised from a mere formula of mathematical dynamics to the position it now holds of a principle pervading all nature and guiding the investigator in every field of science. We may summarise the natural sources of energy as tides, food, fuel, wind, and rain. Among the practical sources of energy thus exhaustively enumerated, there is only one not derived from sun-heat—that is, the tides. Consider it first. I have called it practical, because tide-mills exist. But the places where they can work usefully are very rare, and the whole amount of work actually done by them is a drop to the ocean of work done by other motors. A tide of two metres' rise and fall, if we imagine it utilised to the utmost by means of ideal water-wheels doing with perfect economy the whole work of filling and emptying a dock-basin in infinitely short times at the moments of high and low water, would give just one metre-ton per square metre of area. This work done four times in the 24 hours amounts to 1-1 620th of the work of a horse-power. Parenthetically, in explanation, I may say that the French metrical equivalent (to which, in all scientific and practical measurements, we are irresistibly drawn, notwithstanding a dense barrier of insular prejudice most detrimental to the islanders)—the French metrical equivalent of James Watt's "horse-power" of 550 foot-pounds per second, or 33,000 foot-pounds per minute, or nearly two million foot-pounds per hour, is 75 metre-kilogrammes per second, or 4½ metre-tons per minute, or 270 metre-tons per hour. The French ton of 1,000 kilogrammes used in this reckoning is 0·984 of the British ton. Returning to the question of utilising tidal energy, we find a dock area of 162,000 square metres (which is a little more than 400 metres square) required for 100 horse-power. This, considering the vast costliness of dock construction, is obviously prohibitory of every scheme for economising tidal energy by means of artificial dock-basins, however near to the ideal perfection might be the realised tide-mill, and however convenient and non-wasteful the accumulator—whether Faure's electric accumulator, or other accumulators of energy hitherto invented or to be invented—which might be used to store up the energy yielded by the tide-mill during its short harvests about the times of high and low water, and to give it out when wanted at other times of the six hours. There may, however, be a dozen places possible in the world where it could be advantageous to build a sea-wall across the mouth of a natural basin or estuary and to utilise the tidal energy of filling it and emptying it by means of sluices and water-wheels. But if so much could be done, it would in many cases take only a little more to keep the water out altogether, and make fertile land of the whole basin.

Turning now to sources of energy derived from sun-heat, let us take the wind first. When we look at the register of British shipping and see 40,000 vessels, of which about 10,000 are steamers and 30,000 sailing ships, and when we think how vast an absolute amount of horse-power is developed by the engines of those steamers, and how considerable a proportion it forms of the whole horse-power taken from coal annually in the whole world at the present time, and when we consider the sailing ships of other nations, which must be reckoned in the account, and throw in the little item of windmills, we find that, even in the present days of steam ascendancy, old-fashioned wind still supplies a large part of all the energy used by man. But however much we may regret the time when Hood's young lady, visiting the fens of Lincolnshire at Christmas, and writing to her dearest friend in London, describes the delight of sitting in a bower and looking over the wintry plain, not desolate, because "windmills lend revolving animation to the scene," we cannot shut our eyes to the fact of a lamentable decadence of wind-power. Is this decadence permanent, or may we hope that it is only temporary? The subterranean coal stores of the world are becoming exhausted surely, and not slowly, and the price of coal is upward bound—upward bound on the whole, though no doubt it will have its ups and downs in the future as it has had in the past, and as must be the case in respect to every marketable commodity. When the coal is all burnt, or long before it is all burnt, when there is so little of it left and the coal mines from which that little is to be excavated are so distant and deep and hot that its price to the consumer is greatly higher than at present, it is most probable that windmills or windmoters, in some form, will again be in the ascendant, and that wind will do man's mechanical work on land, at least, in proportion comparable to its present doing of work at sea. Even now it is not utterly chimerical to think of wind superseding coal in some places for a very important part of its present duty—that of giving light. Indeed, now that we have dynamos and Faure's accumulator, the little wanted to let the thing be done is cheap windmills. A Faure cell containing 20 kilogrammes of lead and minium charged and employed to excite incandescent vacuum lamps has a light-giving capacity of 60-candle hours (I have found considerably more in experiments made by myself; but I take 60 as a safe estimate). The charging may be done uninjuriously, and with good dynamical economy in any time from six hours to 12, or more. The drawing off of the charge for use may be done safely, but somewhat wastefully, in two hours, and very economically in any time of from five hours to a week, or more. Calms do not last often longer than three or four days at a time. Suppose, then, that a five days' storage capacity suffices (there may be a little steam-engine ready to be set to work at any time after a four days' calm, or the user of the light may have a few candles or oil lamps in reserve, and be satisfied with them when the wind fails for more than five days). One of the 20 kilogramme cells charged when the windmill works for five or six hours at any time, and left with its 60 candle hours' capacity to be used six hours a day for five days, gives a two-candle light. Thus, 32 such accumulator cells so used would give as much light as four burners of London 16-candle gas. The probable cost of dynamo and accumulator does not seem fatal to the plan, if the windmill could be had for something comparable with the prime cost of a steam engine capable of working at the same horse-power as the windmill when in good action. But windmills, as hitherto made, are very costly machines, and it does not seem probable that, without inventions not yet made, wind can be conomically used to give light in any considerable class of cases, or to put energy into store for work of other kinds. Consider, lastly, rain power. When it is to be had in places where power is wanted for mills or factories of any kind, water power is thoroughly appreciated. From time immemorial water motors have been made in large variety for utilising rain power in the various conditions in which it is presented, whether in rapidly-flowing rivers, in natural waterfalls, or stored at heights in natural lakes or artificial reservoirs. Improvements and fresh inventions of machines of this class still go on, and some of the finest principles of mathematical hydrodynamics have, in the lifetime of the British Association, and, to a considerable degree, with its assistance, been put in requisition for perfecting the theory of hydraulic mechanism and extending its practical applications. A first question occurs—are we necessarily limited to such natural sources of water power as are supplied by rain falling on hill country, or may we look to the collection of rain water in tanks placed artificially at sufficient heights over flat country to supply motive power economically by driving water wheels? To answer it: suppose a height of 100 metres, which is very large for any practicable building or for columns erected to support tanks; and suppose the annual rainfall to be three-quarters of a metre (30 inches). The annual yield of energy would be 75 metre-tons per square metre of the tank. Now, one horse-power for 365 times 24 hours is 236,500 foot-tons; and, therefore (dividing this by 75), we find 3,153 square metres as the area of our supposed tank required for a continuous supply of one horse-power. The prime cost of any such structure, not to speak of the value of the land which it would cover, is utterly prohibitory of any such plan for utilising the motive power of rain.

We may or may not look forward hopefully to the time when windmills will again "lend revolving animation" to a dull, flat country; but we certainly need not be afraid that the scene will be marred by forests of iron columns taking the place of natural trees, and gigantic tanks overshadowing the fields and blackening the horizon. To use rain-power economically on any considerable scale we must look to the natural drainage of hill country and take the water where we find it, either actually falling or stored up and ready to fall, when a short artificial channel or pipe can be provided for it at moderate cost. The expense of aqueducts or of underground water pipes to carry water to any great distance—any distance of more than a few miles or a few hundred yards—is much too great for economy when the yield to be provided for is power, and such works can only be undertaken when the water itself is what is wanted. Incidentally, in connection with the water supply of towns, some part of the energy due to the head at which it is supplied may be used for power. There are, however, but few cases (I know of none except Greenock) in which the energy to spare over and

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above that devoted to bringing the water to where it is wanted, and causing it to flow fast enough for convenience at every opened tap in every house or factory, is enough to make it worth while to make arrangements for letting the water-power be used without wasting the water-substance. The cases in which water-power is taken from a town supply are generally very small, such as working the bellows of an organ, or "hair brushing by machinery," and involve simply throwing away the used water. The cost of energy thus obtained must be something enormous in proportion to the actual quantity of the energy, and it is only the smallness of the quantity that allows the convenience of having it when wanted at any moment to be so dearly bought. For anything of great work by rain power, the water wheels must be in the very place where the water supply with natural fall is found. Such places are generally far from great towns, and the time is not yet come when great towns grow by natural selection beside waterfalls for power, as they grow beside navigable rivers for shipping. Thus hitherto the use of water power has been confined chiefly to isolated factories which can be conveniently placed and economically worked in the neighbourhood of natural waterfalls. But the splendid suggestion made about three years ago by Mr. Siemens, in his presidental address to the Institution of Mechanical Engineers, that the power of Niagara might be utilised by transmitting it electrically to great distances, has given quite a fresh departure for design in respect to economy of rain power.

From the time of Joule's experimental electro-magnetic engines developing 90 per cent. of the energy of a voltaic battery in the form of weights raised, and the theory of the electro-magnetic transmission of energy completed thirty years ago on the foundation afforded by the train of experimental and theoretical investigations by which he established his dynamical equivalent of heat in mechanical, electric, electro-chemical, chemical, electro-magnetic, and thermo-electric phenomena, it had been known that potential energy from any available source can be transmitted electro-magnetically by means of an electric current through a wire and directed to raise weights at a distance, with unlimitedly perfect economy. The first large-scale practical application of electro-magnetic machines was proposed by Holmes in 1854, to produce the electric light for lighthouses, and persevered in by him till he proved the availability of his machine to the satisfaction of the Trinity House and the delight of Faraday in trials at Blackwall in April, 1857, and it was applied to light the South Foreland lighthouse on Dec. 8, 1858. This gave the impulse to invention, by which the electro-magnetic machine has been brought from the physical laboratory into the province of engineering, and has sent back to the realm of pure science a beautiful discovery, that of the fundamental principle of the dynamo, made triply and independently, and as nearly as may be simultaneously, in 1867, by Dr. Werner Siemens, Mr. S. A. Varley, and Sir Charles Wheatstone; a discovery which constitutes an electro-magnetic analogue to the fundamental electrostatic principle of Nicholson's revolving doubler, resuscitated by Mr. C. F. Varley in his instrument "for generating electricity," patented in 1860; and by Holtz in his celebrated electric machine; and by myself in my "replenisher" for multiplying and maintaining charges in Leyden jars, for heterostatic electrometers, and in the electrifier for the siphon of my recorder for submarine cables. The dynamos of Gramme and Siemens, invented and made in the course of these fourteen years since the discovery of its fundamental principle, give now a ready means of realising economically on a large scale for many important practical applications, the old thermo-dynamics of Joule in electro-magnetism; and, what particularly concerns us now in connection with my present subject, they make it possible to transmit electro-magnetically the work of waterfalls through long insulated conducting wires, and use it at distances of fifties or hundreds of miles from the source, with excellent economy—better economy, indeed, in respect to proportion of energy used to energy dissipated than almost anything known in ordinary mechanics and hydraulics for distances of hundreds of yards instead of hundreds of miles. In answer to questions put to me in May, 1879, by the Parliamentary Committee on Electric Lighting, I gave a formula for calculating the amount of energy transmitted, and the amount dissipated by being converted into heat on the way, through an insulated copper conductor of any length, with any given electromotive force applied to produce the current. Taking Niagara as example. and with the idea of bringing its energy usefully to Montreal, Boston, New York, and Philadelphia, I calculated the formula for a distance of 300 British statute miles (which is greater than the distance of any of those four cities from Niagara, and is the radius of a circle covering a large and very important part of the United States and British North America), I found almost to my surprise that, even with so great a distance to be provided for, the conditions are thoroughly practicable with good economy, all aspects of the case carefully considered. The formula itself will be the subject of a technical communication to Section A in the course of the meeting on which we are now entering. I, therefore, at present restrict myself to a slight statement of results. 1. Apply dynamos driven by Niagara to produce a difference of potential of 80,000 volts between a good earth-connection and the near end of a solid copper wire of half an inch (1·27 centimetre) diameter, and 300 statute miles (483 kilometres) length. 2. Let resistance by driven dynamos doing work, or by electric lights, or, as I can now say, by a Faure battery taking in a charge, be applied to keep the remote end of a potential differing by 64,000 volts from a good earth-plate there. 3. The result will be a current of 240 webers through the wire taking energy from the Niagara end at the rate of 26,250 horse-power, losing 5,250 (or 20 per cent.) of this by the generation and dissipation of heat through the conductor and 21,000 horse-power (or 80 per cent. of the whole) on the recipients at the far end. 4. The elevation of temperature above the surrounding atmosphere, to allow the heat generated in it to escape by radiation and be carried away by convection is only about 20deg. centigrade; the wire being hung freely exposed to air like an ordinary telegraph wire supported on posts. 5. The striking distance between flat metallic surfaces with difference of potentials of 80,000 volts (or 5,000 Daniell's) is (Thomson's "Electrostatics and Magnetism," section 340) only 18 millimetres, and, therefore, there is no difficulty about the insulation. 6. The cost of the copper wire, reckoned at 8d. per lb., is £39,000; the interest on which at 5 per cent. is £1,900 a year. If 5,250 horse-power at the Niagara end costs more than £1,900 a year, it would be better economy to put more copper into the conductor; if less, less. I say no more on this point at present, as the economy of copper for electric conduction will be the subject of a special communication to the section. I shall only say, in conclusion, that one great difficulty in the way of economising the electrical transmitting power to great distances (or even to moderate distances of a few kilometres) is now overcome by Faure's splendid invention. High potential, as Siemens, I believe, first pointed out, is the essential for good dynamical economy in the electric transmission of power. But what are we to do with 80,000 volts when we have them at the civilised end of the wire? Imagine a domestic servant going to dust an electric lamp with 80,000 volts on one of its metals! Nothing above 200 volts ought on any account ever to be admitted into a house or ship or other place where safeguards against accident cannot be made absolutely and for ever trustworthy against all possibility of accident. In an electric workshop 80,000 volts is no more dangerous than a circular saw. Till I learned Faure's invention I could but think of step-down dynamos, at a main receiving station, to take the energy direct from the electric main with its 80,000 volts, and supply it by secondary 200-volt dynamos or 100-volt dynamos, through proper distributing wires, to the houses and factories and shops where it is to be used for electric lighting, and sewing machines, and lathes, and lifts, or whatever other mechanism wants driving power. Now the thing is to be done much more economically, I hope, and certainly with much greater simplicity and regularity by keeping a Faure battery of 40,000 cells always being charged direct from the electric main, and applying a methodical system of removing sets of 50, and placing them on the town supply circuits, while other sets of 50 are being regularly introduced into the great battery that is being charged, so as to keep its number always within 50 of the proper number, which would be about 40,000 if the potential at the emitting end of the main is 80,000 volts.

ON SOME APPLICATIONS OF ELECTRIC ENERGY TO HORTICULTURAL AND AGRICULTURAL PURPOSES.*

BY C. WM. SIEMENS, D.C.L., LL.D., F.R.S., MEM. INST. C.E.

On the 1st March, 1880, I communicated to the Royal Society a paper "On the Influence of Electric Light upon Vegetation, &c.," in which I arrived at the conclusion that electric light was capable of producing upon plants effects comparable to those of solar radiation; that chlorophyl was produced by it, and that bloom and fruit rich in aroma and colour could be developed by its aid. My experiments also went to prove that plants do not, as a rule, require a period of rest during the twenty-four hours of the day, but make increased and vigorous progress if subjected (in winter time) to solar light during the day and to electric light during the night.

During the whole of last winter I continued my experiments on an enlarged scale, and it is my present purpose to give a short account of these experiments, and of some further applications of electric energy to farming operations (including the

* Paper read at the British Association.

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pumping of water, the sawing of timber, and chaff and root cutting) at various distances not exceeding half a mile from the source of power, giving useful employment during the daytime to the power-producing machinery, and thus reducing indirectly the cost of the light during the night time.

The arrangement consists of a high pressure steam engine of 6 horse-power nominal, supplied by Messrs. Tangye Brothers, which gives motion to two dynamo machines (Siemens D), connected separately to two electric lamps, each capable of emitting a light of about 4,000 candle-power. One of these lamps was placed inside a glass house of 2,318 cubic feet capacity, and the other was suspended at a height of 12 to 14 feet over some sunk green houses. The waste steam of the engine was condensed in a heater, whence the green houses take their circulating supply of hot water, thus saving the fuel that would otherwise be required to heat the stoves.

The experiments were commenced on the 23rd October, 1880, and were continued till the 7th May, 1881. The general plan of operation consisted in lighting the electric lights at first at 6 o'clock, and during the short days at 5 o'clock every evening, except Sunday, continuing their action until dawn.

The outside light was protected by a clear glass lantern, whilst the light inside the house was left naked in the earlier experiments, one of my objects being to ascertain the relative effect of the light under these two conditions. The inside light was placed at one side over the entrance into the house, in front of a metallic reflector, to save the rays that would otherwise be lost to the plants inside the house.

The house was planted in the first place with peas, French beans, wheat, barley, and oats, as well as with cauliflowers, strawberries, raspberries, peaches, tomatoes, vines, and a variety of flowering plants, including roses, rhododendrons, and azaleas. All these plants, being of a comparatively hardy character, the temperature in this house was maintained as nearly as possible at 60 deg. Fahr.

The early effects observed were anything but satisfactory, while under the influence of the light suspended in the open air over the sunk houses the beneficial effects due to the electric light observed during the previous winter repeated themselves. The plants in the house with the naked electric light soon manifested a withered appearance. Was this result the effect of the naked light, or was it the effect of the chemical products—nitrogenous compounds and carbonic acid—which are produced in the electric arc?

Proceeding on the first-named assumption, and with a view of softening the ray of the electric arc, small jets of steam were introduced into the house through tubes, drawing in atmospheric air with the steam, and producing the effects of clouds interposing themselves in an irregular fashion between the light and the plants. This treatment was decidedly beneficial to the plants, although care had to be taken not to increase the amount of moisture thus introduced beyond certain limits. As regards the chemical products—carbonic acid and nitrogenous compounds—it was thought that these would prove rather beneficial than otherwise in furnishing the very ingredients upon which plant life depends, and further that the constant supply of pure carbonic acid resulting from the gradual combustion of the carbon electrodes might render a diminution in the supply of fresh air possible, and thus lead to economy of fuel. The plants did not, however, take kindly to these innovations in their mode of life, and it was found necessary to put a lantern of clear glass round the light, for the double purpose of discharging the chemical products of the arc and of interposing an effectual screen between the arc and the plants under its influence.

The effect of interposing a mere thin sheet of clear glass between the plants and the source of electric light was most striking. On placing such a sheet of clear glass so as to intercept the rays of the electric light from a portion only of a plant, for instance a tomato plant, it was observed that in the course of a single night the line of demarcation was most distinctly shown upon the leaves. The portion of the plant under the direct influence of the naked electric light, though at a distance from it of nine to ten feet, was distinctly shrivelled, whereas that portion under cover of the clear glass continued to show a healthy appearance, and this line of demarcation was distinctly visible on individual leaves. Not only the leaves, but the young stems of the plants soon showed signs of destruction when exposed to the naked electric light, and these destructive influences were perceptible, though in a less marked degree, at a distance of twenty feet from the source of light.

A question here presents itself that can hardly fail to excite the interest of the physiological botanist. The clear glass does not apparently intercept any of the luminous rays, which cannot, therefore, be the cause of the destructive action. Professor Stokes has shown, however, in 1853, that the electric arc is particularly rich in highly refrangible invisible rays, and that these are largely absorbed in their passage through clear glass; it therefore appears reasonable to suppose that it is those highly refrangible rays beyond the visible spectrum that work destruction on vegetable cells, thus contrasting with the luminous rays of less refrangibility, which, on the contrary, stimulate their organisation.

Being desirous to follow up this inquiry a little further, I sowed a portion of the ground in the experimental conservatory with mustard and other quick-growing seeds, and divided the field into equal radial portions by means of a framework, excluding diffused light, but admitting light at equal distances from the source. The first section was under the action of the naked light, the second was covered with a pane of clear glass, the third with yellow glass, the fourth with red, and the fifth with blue glass. The relative progress of the plants was noted from day to day, and the differences of effect upon the development of the plants was sufficiently striking to justify the following conclusions, viz.:—Under the clear glass the largest amount of, and most vigorous growth was induced, the yellow glass came next in order, but the plants, though nearly equal in size, were greatly inferior in colour and thickness of stem to those under the clear glass, the red glass gives rise to lanky growth and yellowish leaf, while the blue glass produces still more lanky growth and sickly leaf. The uncovered compartment showed a stunted growth, with a very dark and partly shrivelled leaf. It should be observed that the electric light was kept on from five p.m. till six a.m. every night except Sunday during the experiment, which took place in January, 1881, but that diffused daylight was not excluded during the intervals, also that circulation of air through the dividing framework was provided for.

These results are confirmatory of those obtained by Dr. J. W. Draper* in his valuable researches on plant life in the solar spectrum in 1843, which led him to the conclusion in opposition to the then prevailing opinion that the yellow ray, and not the violet ray, was most efficacious in promoting the decomposition of carbonic acid in the vegetable cell.

Having, in consequence of these preliminary inquiries, determined to surround the electric arc with a clear glass lantern, more satisfactory results were soon observable. Thus, peas which had been sown at the end of October produced a harvest of ripe fruit on the 16th February, under the influence, with the exception of Sunday nights, of continuous light. Raspberry stalks put into the house on the 16th December produced ripe fruit on the 1st of March, and strawberry plants put in about the same time produced ripe fruit of excellent flavour and colour on the 14th February. Vines which broke on the 26th of December produced ripe grapes of stronger flavour than usual on the 10th of March. Wheat, barley, and oats shot up with extraordinary rapidity under the influence of continuous light, but did not arrive at maturity, their growth having been too rapid for their strength, causing them to fall to the ground, after having attained the height of about 12 inches.

Seeds of wheat, barley, and oats planted in the open air, and grown under the influence of the external electric light, produced, however, more satisfactory results; having been sown in rows on the 6th of January, they germinated with difficulty on account of frost and snow on the ground, but developed rapidly when milder weather set in, and showed ripe grain by the end of June, having been aided in their growth by the electric light until the beginning of May.

Doubts have been expressed by some botanists whether plants grown and brought to maturity under the influence of continuous light would produce fruit capable of reproduction; and in order to test this question, the peas gathered on the 16th February from the plants which had been grown under almost continuous light action were replanted on the 18th February. They vegetated in a few days, showing every appearance of healthy growth.

Further evidence on the same question will be obtained by Dr. Gilbert, F.R.S., who has undertaken to experiment upon the wheat, barley, and oats grown as above stated, but still more evidence will probably be required before all doubt on the subject can be allayed.

(TO BE CONTINUED.)

TRAFFIC RECEIPTS FOR AUGUST, 1881.

Companies.	Aug., 1881.	Aug., 1880.	Increase.	Decrease.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	£2,300	£1,886	£414	
Direct Spanish Telegraph Company	1,507	1,197	310	—
Direct United States Cable Company	—	—	—	—
Eastern Extension Telegraph Company	30,349	30,169	180	—
Eastern Telegraph Company	42,797	40,988	1,809	—
Great Northern Telegraph Company	21,200	—	—	—

* See "Scientific Memoirs by J. W. Draper, M.D., LL.D." Memoir X.

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TELEGRAPH SHARE LIST.

Companies.	Closing Prices Sept. 7.		Business Done Week Ending Sept. 7. Highest.	Lowest.
Anglo-American	48,	¼	49¼	47¼
Do. Preferred	77½,	8¼	80½	77½
Do. Deferred	22,	¼	22¼	20¼
Brazil Submarine	10½,	¼	10¾	10¼
Cuba	9½,	10	—	—
Do. Preference	16½,	17	—	—
Direct Spanish	5,	¼	—	—
Do. Preference	14½,	15¼	14¾	14¾
Direct United States Cable	10½,	¼	10¾	9 15-16
Eastern Telegraph	10,	¼	10¼	10¼
Do. 6 per Cent. Preference	12½,	3¼	13¼	13
Do. 5 per Cent. Debentures, 1899	105,	8	—	—
Eastern Extension	10¾,	11	11	10¾
German Union	10,	¼	—	—
Globe Telegraph and Trust Company	6,	¼	6¼	6¼
Do. Preference	12½,	¼	12¾	12¾
Great Northern	12½,	3¼	12¾	12¾
Indo-European	28,	29	—	—
Mediterranean Extension	2½,	3	—	—
Do. Preference	9,	¼	9¾	9¾
Reuter's	12,	13	—	—
Submarine	280,	90	—	—
West India and Panama	1½,	2	1¾	1¾
Do. 1st Preference	7,	¼	7¼	7¼
Western Brazilian	7½,	¼	7¼	7 7-16
West. Union 7 per Cent. 1st Mortgage	125,	130	—	—
Do. 6 per Cent. Sterling Bonds	104,	107	—	—

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The next EXAMINATIONS in TECHNOLOGY will be held at the different Provincial Centres throughout the Kingdom on the evening of May 24, 1882.

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The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.
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SLIP

ALGERIA.—Telegraphic communication between the coast and the interior continues to be interrupted.

ANOTHER ELECTRICAL PAPER.—The first number of *Le Moniteur Officiel de L'Electricité* has made its appearance in Paris.

A SEXTUPLEX SYSTEM.—It is reported from America that patents will shortly be taken out for a sextuplex system of telegraphy.

TELEPHONE CONVENTION.—A telephone convention was opened at Congress Hall, Saratoga Springs, New York State, on the 6th of September.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this company for the week ended the 9th inst. amounted to £2,796.

PRESS OF WORK AT MARSEILLES.—Owing to the disturbances in Algeria there is a great press of work in the Marseilles telegraph office.

SWAN'S LAMPS IN A THEATRE.—We hear that Messrs. Siemens will light Mr. D'Oyley Carte's new theatre in the Strand with 600 Swan lamps.

ORIENTAL TELEPHONE COMPANY.—The offices of this company have been removed from No. 6, Lombard-street, to 3, Great Winchester-street, E.C.

TELEGRAPHIC INTERRUPTION IN GREECE.—A Reuter's telegram, dated Athens, 7th September, says that the telegraph wires between Volo and Armyro have been cut.

ELECTRIC LIGHT FOR MEXICO.—The question of adopting the electric light for illuminating the streets of Mexico is stated to be occupying the attention of the authorities.

NEW TELEGRAPH LINE IN AMERICA.—It is stated that a new telegraph line is to be constructed along the Grand Junction Railway from Belleville to Peterborough, in the United States.

SS. "DACIA" IN SHETLAND.—The telegraph steamer Dacia left Lerwick, Shetland, early in this week, to endeavour to lift the second telegraph cable, which lies broken between the Shetland and Orkney Isles.

THE TELEPHONE IN AMERICA.—We hear that Ironton and Portsmouth, O., are now connected by telephone, a distance of 28 miles; also that Ironton and Proctorville are similarly connected, the distance being 24 miles.

TELEGRAMS FOR THE GREEK ISLANDS.—Telegraphic communication has now been established with the Greek Island of Kythira (Cerigo); and telegrams can be forwarded to that island at the rates in force for the island of Spezzia.

ELECTRIC LIGHT IN YORKSHIRE.—We understand that Messrs. Hammond and Co., of London, have secured the sole concession for the Brush system in the county of Yorkshire, and have opened an establishment at Sheffield to work the South Yorkshire districts.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this company for the week ending the 9th September amounted to £1,875, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

ELECTRIC LIGHTING FOR COAL MINES.—In Mr. Jamieson's paper read before the British Association under this title, and given in our last issue, in page 262, the figures 40 and 70 in the illustrations of methods of joining up the lamps represent the mean resistance of the lamps when cold.

THOUGHTFULNESS.—It is reported that the steamer, "Faraday," now laying the mid-section of the new Atlantic cable, having had several articles of gear washed overboard, the captain telegraphed home *viâ* the cable that no uneasiness need be felt if such articles were picked up.

ELECTRIC LIGHT IN HOLLAND.—During the Agricultural Exhibition at Bergen op. Zoom (Holland), three electric lamps were used to light the show with great success. The dynamo-electric machines were made by Mr. William Smit of Slikkerveer, near Rotterdam. The lamps were on the Crompton arc system.

PARIS EXHIBITION—THE JURY.—The number of the jury in the Paris Electrical Exhibition have been finally settled as follows:—France, 75; Belgium, 11; Great Britain and Ireland, 10; Germany, 10; the United States, 7; Italy, 10; Sweden, 5; Switzerland, 4; Spain, 3; Norway, 3; Holland, 3; Hungary, 1; Denmark, 1; and Japan, 1.

PRICES.—The prices as quoted are, for gutta percha per lb.: —Genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber per lb.: Fine Para, 3s. 3d. to 3s. 4d.; negrohead, 1s. 11d.; central American, 1s. 6d. to 2s. 2½d.; Assam and Pegu, 8d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 4d. to 2s. 1½d.

TECHNICAL INSTRUCTION COMMISSION.—The first meeting of the Royal Commission on Technical Instruction was held on Tuesday last, at the South Kensington Museum. The following members attended:—Mr. Bernard Samuelson, M.P., F.R.S., in the chair; Mr. Philip Magnus, B.A., B.Sc.; D. Roscoe, F.R.S.; Mr. Swire Smith; Mr. William Woodall, M.P.; and Mr. Gilbert R. Redgrave, secretary.

THE TRANSMISSION OF POWER.—A prize of 1,000 marks (equal to about £50) is offered by the Electrotechnischer Verein of Berlin for the best essay on the transmission of power by electrical and mechanical means. Essays must be sent in before the 1st of October, 1882. Further particulars as to the conditions of the competition, &c., can be obtained from Herr Julius Springer, Electrotechnischer Verein, Berlin.

CITY AND GUILDS INSTITUTE.—We notice that the classes of this Institute will commence for the next session on the 4th of October. The classes connected with electrical science will be held by Professor W. E. Ayrton, F.R.S., on Monday, Wednesday, and Friday evenings, at the temporary class rooms of the Institute, in Cowper-street, Finsbury. The next technological examinations will be held on the 24th of May next.

ELECTRIC LIGHTING EXHIBITION AT BRIGHTON.—At a largely-attended and influential meeting recently held at Brighton, under the presidency of the mayor, it was unanimously agreed that it was desirable to hold a Domestic, Sanitary, and Scientific Exhibition in the town during the week commencing the 17th of December next. A competitive exhibition of electric lighting is contemplated in connection with the exhibition.

ELECTRICITY AND COAL.—Speaking at the banquet given to some members of the British Association, at Whitby, the other day, Sir George Elliot, Bart., M.P., referred to the probable exhaustion of our coal supply, and to electricity as the probable motive force of the future. He thought, also, that we might look forward to applying the force of water as a substitute for coal, in combination with electricity, compressed air, and hydraulic appliances.

THE ADMIRALTY AND THE PARIS EXHIBITION.—We are glad to hear that the Admiralty, recognising the importance of the Paris Electrical Exhibition, have instructed Mr. J. Farquharson, one of the examiners of dockyard work, a

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couple of officers attached to the Vernon torpedo school, and Mr. Lane, who has charge of the electric workshops under the Chief Constructor at Portsmouth, to visit the Exhibition and report upon the various systems from a service point of view.

Detection of Explosive Gas.—A correspondent suggests the use of the apparatus exhibited by Latimer Clark, Muirhead, and Co. at the Paris Exhibition, and described in our issue of the 3rd inst., page 245, as a means of testing the condition of coal-bunkers on board steam ships. The loss of the Doterel is ascribed primarily to the explosion of gas generated among the coals, and our correspondent suggests that their condition should be tested now and again, as proposed to be done in coal mines, by Liveing's gas indicator, or a modification thereof.

College of Science and Arts, Glasgow.—In addition to the ordinary classes for mathematics, engineering, &c., a course of evening lectures on Telegraph Engineering will be delivered at the College of Science and Arts, 38, Bath-street, Glasgow, by the principal of this college, Mr. A. Jamieson, on Tuesdays, commencing the 1st of November. Should thirty students present themselves, a few lectures on Telephony and Electric Lighting will be added. The lectures are given in connection with the City and Guilds Institute of London. The fee will be seven shillings and sixpence for the session of seven months.

Overhead Telegraph Wires in Washington.—The annual report of the engineers' department of the district of Columbia, recently issued, says that "there are now in the city of Washington 41 miles of telegraph lines, consisting of 1,266 poles, carrying about 336 miles of wire, in addition to telephone and fire alarm wires carried over the tops of the houses, and estimated to amount to 100 miles of wire. . . . . The cost of changing the existing wires from the poles to underground pipes, it is estimated, could probably be brought within 8,000 dollars a mile for a line of 40 conductors, with a reduction of 185 dollars for each conductor less than 40." The report concludes by a strong expression of opinion in favour of the change being made at once.

The Molecular Telephone.—The telephone bearing this name is now being exhibited in London at 37, Walbrook, E.C. Its special feature is the non-use of a detached metallic diaphragm, the sounds being produced in this instrument by one pole of the magnet, of peculiar construction, resting upon, or rather in contact with any substance not actually impervious to sound. We have examined the receiver, and tested it with plates and fragments of wood, glass, ebonite, and even of cork, of irregular shapes, and found the articulation excellent, the crucial test of sibillation being completely satisfactory. One practical advantage of this form of telephone is that it will bear rough usage, no nice adjustment of diaphragm to magnet as in the ordinary telephone being necessary.

Machine Currents for Telegraphy.—According to the *Electrotechnische Zeitschrift*, Herr Joseph Krœmer, Superintendent of Telegraphs of the Joseph Railway, Vienna, so long ago as 1876 successfully employed the currents obtained from a Gramme dynamo machine for telegraphic purposes. Herr Krœmer, in a paper read before the *employés* of the Austrian railways, in October, 1877, showed that for a line of 1,000 kilometres, comprising 100 stations, with six small Callaud cells in each station as a line battery, and as many as a local battery, the cost of working, including materials, was 2,664 florins, and that with ten Gramme machines and printing instruments inserted directly in the line, the cost was only 1,052 florins, supposing that the motive force was obtained under good conditions, at a cost of three kreuzers per hour.

Electrical Rectification of Alcohol.—Electricity is being employed in the rectification of inferior alcohol in distilling by a process due to the late M. Naudin, and now in successful operation on a large scale at the distillery of Bapaume-les-Rouen. The process consists in passing currents of electricity through the inferior alcohols so as to disengage the superfluous hydrogen from them by electrolysis. The electricity is provided in part by a voltaic battery, and in part by the Gramme dynamo-electric machine. The most important result of the new method, in a public sense, is that by its means beetroot alcohol, which is ordinarily poor, can be prepared so as to be of high quality. The common beet spirits can, it is said, be made to yield 80 per cent. of alcohol, equal in quality to that from the best malt, and the process is much simpler and cheaper than the manufacture of alcohol from either malt or potato.

Lighting at Liverpool Docks.—The new docks at the north end, which were formally opened by the Prince of Wales last week, will be lighted throughout by electricity, by means of powerful arc lights, each of 6,000 candle-power, suspended from the tops of lattice work poles 80 feet high. Three of these are already fixed. They differ from those used elsewhere in that each post is self-supporting, without the use of stays or guy lines, which are found to be in the way of the shipping. The dispersal of the light is effected by means of circular, conical-shaped reflectors, enamelled on the inside, which enable a radius of 150 yards round the light to be illuminated sufficiently for the purpose required. It is the intention of the engineer of the Dock Board at present to use the light only at tide time, when vessels are locking in and out. One set of sheds has also been lighted in a most satisfactory manner by electricity, and the system will be extended shortly to the other sheds and graving docks. When a light is required at any particular spot to enable vessels to unload or take in cargo at night a set of portable electric lighting tackle will be supplied which will give from one to three powerful lights. In design it is somewhat similar to the ordinary steam-hoisting winch, and occupies about the same space. The whole of the work has been erected under the superintendence of Mr. Killingworth Hedges, C.E., and has been manufactured by the Electric Lighting Supply Company, of London.

Telegraph Stamps.—The fact of the Bavarian Government having followed the example of Germany, and done away with special stamps for telegrams has led our contemporary, the *Journal Télégraphique*, to give its opinion on this subject, which is as follows:—"With the general and obligatory use of telegraph stamps, our contemporary thinks that the system of special stamps is the best for the administration, even when the postal and telegraph services are combined; but when their use is optional, it is to the advantage both of the administration and the public to use stamps common to both services. There are six European Governments who use stamps for telegrams—viz., Germany, Bavaria, and Spain, who use stamps common to both postal and telegraph service, and Belgium, Great Britain, and Switzerlane, who use special stamps for telegrams. The three first named began with special stamps, but gave them up in favour of common ones. Of the three others, Great Britain is the only one which, unlike the three first named, having begun with a common stamp, has finally adopted a special one, the two others, Belgium and Switzerland, having never

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altered their first plan." After having examined the different systems in detail, our contemporary finds that where the Government endeavours to simplify matters by the obligatory use of telegraph stamps the system of special stamps is in vogue, but where their use is optional and the public convenience is considered stamps common to both services prevail. This seems to be the practical outcome of the theoretical discusssion of the question.

EFFECTS OF LIGHTNING ON TREES NEAR A TELEGRAPH WIRE.—Some instructive facts in this connection have been brought to light by M. Montigny, in a recent examination of poplars bordering part of a road in Belgium between Rochefort and Dinant. The part in question is some 4,600 metres in length, and runs westward; it is level for some distance, then rises gradually to a height of 61 metres, through a wood, traverses a wooded plateau 200 metres in extent, then descends, still through wood, to a plain. A telegraph wire runs near the row of Virginia poplars on the north side, and it appears that, out of nearly 500 poplars forming this row, 81, or a sixth, have been struck by lightning. Hardly any have been struck in the other row. The trunks have been mostly struck on their south side and nearly opposite the wire. Comparing different portions of the road, it is found that in the horizontal part none of the 129 trees show injury from lightning, or at most only one (a doubtful case), but as the road rises through the wood the cases quickly multiply, and on the wooded plateau as many as nine out of fourteen trees, or 64 per cent., have been struck. On the slopes the proportion is 25 per cent. M. Montigny distinguishes three kinds of injuries—(1) the bark torn and detached on a limited part of the trunk; (2) a furrow, straight or (rarely) spiral, made on the tree, from near the wire down to the ground; and (3) a peculiar oval wound, with longer axis vertical, and lips coloured light brown. M. Montigny is of opinion that the lightning, while provoked by the wire, does not strike this first, then the tree, but strikes the tree directly. His conception of the process is to the following effect:—Suppose a thunder-cloud charged with positive electricity. A long telegraph wire under it, though insulated, may acquire as great negative tension in the nearest part as if in direct communication with the ground, and the tension is greater the nearer to the cloud. While the inductive influence affects the wire most, near objects, such as trees, share in the influence according to their conducting power. The lightning, attracted in the direction of the wire, yet does not strike this, the insulating cups presenting an obstacle to its prompt and rapid escape. It finds a better conductor to earth in a neighbouring poplar, wet with rain. From the facts indicated it results that of two similar houses, one built on a plain the other in a wood, and having a telegraph wire fixed to them, the latter is the more liable to injury by lightning, and the danger is greater if the wood enclosing the house be upon an eminence.

ELECTROLYSIS FROM A CHEMICAL POINT OF VIEW.—This is the title of an article by M. A. Guerout in a recent number of *La Lumière Electrique* M. Guerout divides electrolysis into two heads—that in which the positive electrode (made of the same metal as that which is deposited) dissolves during the operation, and that in which this electrode is insoluble. Take, for instance, a dynamo-electric machine revolving at a constant rate of speed, and having for external circuit a metal conductor with resistance for this speed at its maximum. Replace a fraction of this external circuit by a sulphate of copper voltameter of equal resistance to the portion of the circuit taken away, and suppose we keep on replacing portions of the circuit by voltameters until the latter form a conductor of the same resistance as the first, the same quantity of electricity will pass through all the voltameters, and will produce in all the same deposit. The deposit of copper will, therefore, be proportional to the number of voltameters. The number of voltameters may be increased without diminishing the intensity of the current by increasing at the same time the surface of the electrodes without changing the total resistance. The deposit of copper will thus be increased, and as the resistance is the same, the expenditure of work is not increased. Thus, in the case of electrolysis by means of soluble electrodes, the quantity of metal deposited can be increased almost indefinitely for the same expenditure of work. This theory has been practically verified by M. Gramme (*vide* the *Revue Industrielle*, p. 345, 1877), and again by M. Niaudet, in his recent work on magneto and dynamo-electric machines. In the second case, the one which is most frequently employed in chemistry, viz., in which the positive electrode is insoluble, as, for instance, platinum, the introduction of a voltameter into the circuit, whilst it does not affect the resistance, reduces the intensity of the current. The chemical work of deposition is not, in fact, compensated for by the work of dissolution, and there is developed in the voltameter a counter electromotive force, representing the chemical work done. The more voltameters introduced into the circuit the greater this counter force, and the greater the expenditure of work in the machine. Few experiments have, unfortunately, been made in this direction, and we have only the facts relating to copper as published in the *Electrotechnische Zeitschrift*, and reproduced in *La Lumière Electrique* for the 19th of March, 1881, p. 218. Thus one Siemens quantity machine, with an E.M.F. of about three volts, and an internal resistance of 0·007 ohms, and an external circuit of 12 copper precipitating baths, deposited with an expenditure of 10 h.-p. about 300 kilos of copper in twenty-four hours, or 1,250 grammes per horse-power per hour. Now, we may find the intensity of the current from this. Taking Weber's figures, lately verified by M. Mascart—viz., that a current of 96 webers traversing a voltameter decomposes an equivalent per second of the electrolyte expressed in milligrammes, we have as the intensity of the current traversing the 12 baths about 800 webers; on the other hand, the equivalent of copper is 31·75. In each bath, therefore, the current will deposit $\frac{0 \text{ gr. } 03175 \times 800}{96}$ of copper per second. Per hour this deposit will be $\frac{0{\cdot}03175 \times 800 \times 3600}{96}$ or 952 gr., and for the twelve baths 11·424 k. This deposit, corresponding to an expenditure of 10 horse-power, gives 1142·4 gr. per horse-power. As will be seen, this figure is very close to the one obtained in practice, and the difference may be set down to the fact that the results given in the *Electrotechnische Zeitschrift* were only approximate. Suppose now that we substitute for the copper baths voltameters with dilute acid, the intensity of the current being still maintained at 800 webers, we should have as equivalents, taking as a basis the figure 1142·4 gr. of the copper, 205 litres of oxygen per hour. But as the counter electromotive force developed in this case would be greater than in the case of the copper deposition, the expenditure of work would be greater and would be more than one horse-power. M. Guerout concludes by pointing out the advantage which would accrue by persons making known the results they may have obtained in the process of electrolysis with other bodies than copper.

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REPORT OF ELECTRICAL STANDARDS COMMISSION.

APPENDIX II.

ON THE CAUSES OF THE VARIATION IN THE TEMPERATURE COEFFICIENT OF THE ALLOYS OF PLATINUM AND SILVER.

BY H. A. TAYLOR.

In his report to the Committee of the British Association in 1862 Dr. Matthiessen proposed for the construction of standard resistance coils the now widely-used alloy of silver and platinum, consisting of two parts of silver and one part of platinum by weight. In the same paper he gave the specific conducting power of the material, and also its percentage variation in resistance due to a change of temperature of 1° centigrade. The latter value, called the temperature coefficient in what follows, he stated to be 0·031 per cent. per degree. It was, however, found after the alloy came into general use that the temperature coefficient varied within moderately wide limits; and it was noticed by the writer, amongst others, that having determined by experiment the coefficient of a particular wire, it was necessary to make a fresh determination for the same wire when drawn down to a finer gauge. An investigation into the causes of these variations was, therefore, desirable, and at the request of your committee it has been undertaken by myself. As yet no very definite result has been reached, but the observations already made, involving much care and a very large expenditure of time, and the method of experimenting employed may, perhaps, be worth recording. Throughout the investigation I have had the benefit of the co-operation of Mr. Charles Hockin.

To better observe the variation in the temperature coefficient with change of diameter, rods of considerable sectional area, to be afterwards drawn into wire, were obtained from Messrs. Johnson and Matthey. The first rod (called hereafter Bar A) was of the commercial alloy manufactured specially for electrical purposes. The metals used are commercially pure, and are melted together in large quantities. The alloy is then cast as a flat ingot, not more than an inch or an inch and a half in depth, and this ingot is next rolled into a large sheet about 0·3 inch thick, which is cut by shears into narrow strips. These strips are finally passed between grooved rollers, to give them an approximately circular section, and the rods thus formed are ready for the draw plates to reduce them to wire of the required diameter. The bar experimented on was in the "rod" stage, about eight inches long and 0·27 inch in diameter. The second rod (called hereafter Bar B) was specially made for these experiments of pure materials by Messrs. Johnson and Matthey. It was cast in the form of a bar about eight inches long. On leaving the mould it was about 0·3 inch square, slightly tapering, and more or less irregular in section, but was reduced in the lathe and by filing to a section almost absolutely square and uniform. The third rod (called Bar C) was of an alloy made by the same firm for the use of dentists, the method of casting and rolling being the same as that described for the electrical alloy, but rather less attention is paid to the purity of the components. It was procured in the form of a narrow strip about a quarter of an inch thick, and reduced to an uniform square section by the lathe and file. As it was necessary to observe accurately the small percentage variation, due to change of temperature, in the resistance of these bars, which was itself exceedingly minute, recourse was had to the method of observation originally proposed by Mr. C. Hockin, and described and figured in Clerk Maxwell's "Electricity and Magnetism," pp. 406 and 407, Vol. 1, by means of which the unavoidable resistance of the connections can be altogether eliminated. Instead, however, of using, as shown in the figure referred to, a comparatively short wire with resistance bobbins at its ends, a wire 40ft. in length wound on a cylinder was employed, so that the bobbins could be dispensed with, without loss of accuracy and with a great gain in simplicity of calculation and in range. To avoid the very great expense of a necessarily thick wire of iridio-platinum, which was, however, recognised to be the best material, a German silver wire was, in the first instance, fitted to the cylinder and calibrated, but after a short time it was found to get loose in its groove, so that the readings obtained on it could not be depended on. A platinum-silver wire was next tried, and though most carefully drawn the calibration showed such a want of uniformity in the conducting power at different parts of its length that it was at once discarded. Finally, an iridio-platinum wire

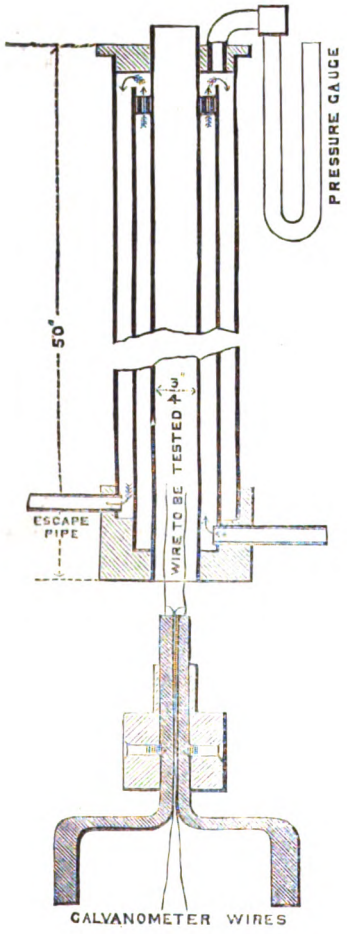

FIG. 2.

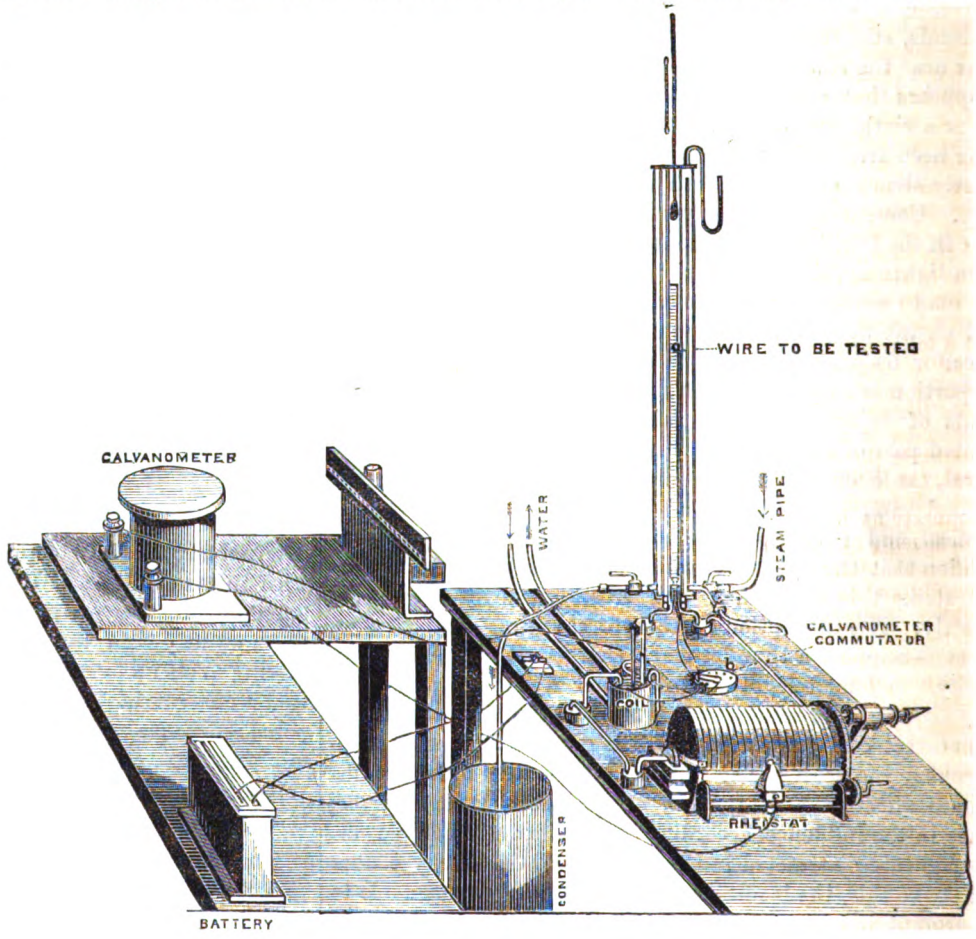

FIG. 1.

* Presented to the British Association, York Meeting, 1881.

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was obtained from Messrs. Johnson and Matthey, fitted to the cylinder and calibrated, but the result not being considered quite satisfactory, the wire was removed, carefully annealed, drawn through one hole in a draw plate, and remounted, but with very little better results. This operation was repeated without advantage, and it became evident that the want of uniformity in the conducting power was not due to irregularities in the section of the wire, but was to be attributed in all probability to want of uniformity in the composition of the alloy. To avoid further loss of time it was therefore decided to make use of the wire as it then was, and to correct all readings by the result of an accurate and close calibration. The wire was therefore calibrated in 100 equal parts by a method devised after trying one or two others, and found to be very accurate and convenient. It is fully described in an appendix at the end of this paper. The wire is wound in 20 convolutions in a spiral groove accurately formed in the cylindrical surface of an insulating drum. The ends of the wire are soldered to massive bars, each brazed to one axle of the drum, which terminates in an amalgamated copper disc half immersed in a cup of mercury. These mercury cups are themselves connected with the rest of the apparatus by means of very stout copper rods. The contact piece by means of which the galvanometer is put in circuit is mounted on a brass block moving between two brass rods and traversed by a screw after the fashion of the slide rest of a lathe. One end of the screw carries a toothed wheel gearing with another wheel attached to the drum and concentric with it. The pitch of the screw and the gearing are so calculated that, when the drum is made to revolve, the contact piece, whilst moving in a horizontal line parallel with the axis of the drum, is always in contact with some point of the wire, upon which it presses lightly by means of a spring. The brass toothed wheel has a slightly greater diameter than the drum to which it is attached. On the flat exterior side near its circumference it is divided into 1,000 equal parts, and by means of a microscope with cross wire eye piece, the divisions can be read by estimation to tenths, and easily to fifths. As there are twenty turns, the whole wire can, therefore, be accurately divided into 100,000 parts. Whole turns of the wire are shown by the divisions of a horizontal scale close to the contact piece. To maintain the wire throughout its length at a uniform temperature, the drum is enclosed in a wooden case in which openings are left for the contact piece and microscope. A sketch of the connections is given (Fig. 1). To determine the temperature coefficients of the various bars and wires their resistances at two different temperatures were compared with that of a standard maintained as nearly as possible at a constant temperature. The higher temperature of comparison was generally nearly that of boiling water, and was maintained by means of steam. The bars were immersed in a bath of melted paraffin wax, the interior surface of the bath being lined throughout with convolutions of ¼-inch "compo" gas tubing, through which steam was caused to flow. The lower temperature was about that of the air, the bath just described was again used, but paraffin oil was substituted for the wax, and cold water from the main was made to circulate in the pipe instead of steam. In both cases the paraffin oil or wax was kept continually stirred. The standard was also immersed in paraffin oil kept at a uniform temperature by the circulation of water from the main through tubing in the containing vessel. The paraffin oil used possesses remarkably high insulating qualities. Bobbins of silk-covered wire, even of many thousand ohms resistance, could be immersed in it without the least sensible leakage from spire to spire. It is sold under the name of "Strange's Crystal Oil." The apparatus for maintaining the desired temperature when the alloy is in the form of wire is far more convenient than that described above for the bars. It resembles the instrument used for testing the boiling point of thermometers. It is shown in section in the accompanying sketch (Fig. 2), and consists of an open tube about ¾ inch in diameter, surrounded by a second tube, closed at the bottom and opening at the top into the outer tube, which is closed at both ends. The supply pipe leads into the annular space between the inner tube and the second tube near the bottom, and the exhaust or escape pipe from the space between the second tube and the outer tube. When steam is allowed to enter by the supply pipe, it completely envelopes in its passage the inner tube, and external influences, such as sudden draughts of air, are effectually cut off by the steam jacket between the second tube and the outer tube. For observations at ordinary temperature, water is allowed to flow into the supply pipe instead of steam, and a convenient system of pipes and cocks allows the change to be made from steam to water, or *vice versâ*, with facility. When steam is used a mercurial gauge is provided to indicate the difference of pressure between the inside of the tube and the atmosphere.

The temperature calculated from the reading of this gauge and that of the barometer was found to agree within $\frac{1}{10}$ degree with the indication of the thermometer inserted in the inner tube. The bottom of the inner tube is closed by an ebonite stopper, through which pass two stout copper rods of semi-circular section, so as to have the greatest available cross section. Each is held rigidly in position by a screw passing radially through the ebonite stopper, and they are insulated one from the other by an air space through which pass the wires for the galvanometer connections, the interstices being afterwards filled with shellac. The ends of the wire to be tested are soldered to the upper extremities of the copper rods. When the wire is short and thick it is covered with silk, bent double, and passed into the tube; when thin it is wound on a glass rod, and the whole coated with silk ribbon. The space between the wire and tube is filled with lead shot of the smallest size, and a thermometer is inserted in the top of the tube, which is then filled quite up with shot. It was found that the shot had an excellent effect in preventing minute oscillations of temperature due to draughts or similar causes.

The battery used was one large Grove cell, the galvanometer a "dead beat," by White, having a resistance of 1·4 ohm. In most cases the absolute resistance of the specimens of alloy was determined as well as the temperature coefficient. For the bars this was done by comparison with a rod of pure lead of known dimensions. The wires were compared directly with bobbins of known resistance. The sectional area of the bars and wires was always calculated from their weight, specific gravity, and length; all bars and wires were annealed before making the electrical observations.

The following table shows the resistance and temperature coefficient of the first sample of the alloy when in the original bar shape, and when drawn down to wire of various gauges.

BAR A.

Length mm.	Diameter mm.	Resistance of a wire 1 metre long and 1 millimetre diameter at 0° C.	Specific gravity.	Per centage variation in resistance for 1° C.	Remarks.
		Ohms.			
175·67	6·825	0·3658	12·740	·0299	Rod.
996·40	1·578	0·3824	12·733	·0276	
3132·70	0·525	—	12·613	·0273	
2655·25	0·525	0·3937	12·811	·0263	
—	0·203	—	—	·0232	
—	0·168	—	—	·0231	

A complete analysis of this alloy from the end of the rod was made for me by Messrs. Johnson and Matthey. The composition was as follows:—

Platinum	32·95
Silver	66·65
Iridium	0·03
Rhodium	0·01
Iron	0·01
Lead, with minute trace of copper	0·01
Loss	0·34
	100·00

The platinum and silver are thus very nearly in the prescribed proportion, and the amount of impurity is inconsiderable. An assay of a piece cut from one end of the wire 1·578mm. in diameter gave the proportion of platinum as 31·34 per cent. A calibration made from inch to inch in its length showed the conducting power to be sensibly uniform.

BAR B.

The temperature coefficient of this bar was 0·0308 per cent. The specific gravity and absolute resistance were abnormal, and a calibration showed it was quite irregular in conducting power, the casting being porous and full of holes. Messrs. Johnson and Matthey failed in their attempt to roll or draw it down into wire, but a small portion was remelted and drawn into wire 0·67mm. in diameter, of which the specific gravity was 13·354, the temperature coefficient ·0282 per cent., and the calculated resistance of 1 metre of the wire 1mm. in diameter, 0·238 ohm. It was obvious, therefore, that even if the alloy was of the desired composition on the average, it

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had such a want of uniformity that an analysis was not worth making.

BAR C (DENTAL ALLOY).

The table hereafter gives the observations made with this sample of alloy from the bar stage to that of very fine wire.

Length mm.	Diameter mm.	Resistance of a wire 1 metre long and 1 mm. in diameter.	Specific gravity.	Per centage variation in resistance for 1° C.	Remarks.
		Ohms.			
163·00	4·314	0·3770	12·444	0269	Sq. Bar
996·95	1·625	0·3611	12·449	0261	
2416·15	0·535	0·3690	12·630	0266	
—	0·203	—	—	0248	

Messrs. Johnson and Matthey's analysis of this alloy was as follows:—

Platinum	28·9
Silver	70·50
Rhodium	0·01
Iridium	0·02
Iron	0·02
Lead with minute traces of copper and loss	0·50
	100·00

An assay of one end of the wire of the diameter 1·625 mm. gave 28·44 per cent. as the proportion of platinum, but it would appear from the specific gravity of the third observation in the above table that the composition could not be uniform, indeed the bar was calibrated in six parts both at the high and low temperature, and the temperature coefficients for the different parts were found to be as follow:—·028, ·032, ·029, ·036, ·031, and ·029 per cent. per degree.

To examine the effect on the temperature coefficient of a variation in the percentage of platinum and silver, the following alloys were cast by Mr. Hockin and drawn to wire. They were made with pure platinum black and precipitated silver.

Composition of Alloy.		Diameter (approximate).	Per centage variation in resistance for 1°C.	Remarks.
Pt. per cent.	Ag. per cent.	mm.		
40	60	0·234	·0259	
33⅓	66⅔	0·096	·0265	Different castings.
33⅓	66⅔	0·234	·0301	
30	70	0·234	·0313	
25	75	0·234	·0407	
25	75	0·063	·0377	

From the foregoing tables it would appear that a moderate variation in the percentage composition on either side of the normal proportions of two parts silver by weight to one part platinum produces less effect on the temperature coefficient than does a change in the diameter of the wire. It also appears from these and other experiments that it is practically impossible to ensure a uniform mixture of the metals even when the alloy is of the normal composition in the aggregate. Thus, the wire from an unit coil of the B A pattern, made by Dr. Matthiessen, or under his superintendence, was drawn down to a diameter of 0·168 mm. The whole wire had a temperature coefficient of ·0250 per cent., but on examining the wire in two approximately equal portions the temperature coefficient of the two halves was found to be ·0237 and ·0266 per cent. It is, therefore, evident that when the highest attainable accuracy is acquired, as in the construction of standard coils, it is not sufficient to depend upon the general temperature coefficient of the alloy, but that a determination of the coefficient of the particular coil or instrument is required. For less accurate work it would seem that Dr. Matthiessen's value for the coefficient, viz.:—031 per cent. per 1° C, should be reduced by from 5 to 10 per cent. for wires of large diameter, by about 15 per cent. for wires of 0·25 mm. diameter, such as, in general, resistance coils of from 100 to 1,000 ohms are made of, and by from 20 to 25 per cent. for wires of the smallest gauge usually drawn.

CORRESPONDENCE.

THE FAURE BATTERY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Early in June last Sir William Thomson drew public attention to the satisfactory results obtained by him from the Faure battery, submitted for experimental purposes early in the previous month. A few days later he writes:—"I am continuing my experiments on the Faure accumulator with every day increasing interest." Since then I have seen no further publication from him on the subject until his address at the British Association, on the 1st inst., when he mentioned the Faure battery in most favourable terms.

Now, I have anxiously waited to learn something further, for the result of my own experiments has not been of so satisfactory a character as those of Sir William Thomson. This may, perhaps, be due to the fact that he was supplied direct from M. Faure, whilst I, being unable to purchase or procure the loan of similar cells, had them constructed in accordance with the published descriptions. The subject is one of great importance, and there are undoubtedly many, like myself, desirous of arriving at the value of such means for the storage of electricity. I, therefore, send for publication the form of battery constructed by me, together with the results obtained therewith, thinking that the information may be of service to others who are working in the same direction.

Each battery consisted of an insulated box, containing 20 sheets of lead $\frac{1}{32}$ of an inch in thickness, and having a total surface of 10 square feet. Each sheet was covered on both sides with the red oxide of lead, and separated from each other by a sheet of flannel covered on one side only, to within $\frac{3}{4}$in. of its edges, with the same oxide and a sheet of vellum. These sheets were then arranged in the same manner as the plate of a condenser, the lead taking the place of the tinfoil, and the flannel and vellum that of the mica or other dielectric. The whole was then covered with a diluted solution of sulphuric acid, in the proportion of one part acid to ten water. Three such batteries were charged in multiple arc from a dynamo machine, the potential of which was equal to 50 volts. After each charge one cell was tested separately and the remaining two in multiple arc. The following are the results obtained:—

ONE CELL.

Time of charge.	Potential in volts.	Internal Resistance. Ohms.	Work done in minutes.
10′	1·85	·56	17
20′	1·88	·56	88
30′	1·90	·56	152
40′	1·91	·56	275
50′	1·91	·58	485
60′	1·92	·58	375

TWO CELLS JOINED IN MULTIPLE ARC.

10′	1·85	·51	18
20′	1·88	·51	88
30′	1·90	·50	180
40′	1·91	·50	305
50′	1·91	·52	500
60′	1·92	·53	435

These batteries rested six days, and then the above experiments were repeated with the following results:—

ONE CELL.

Time of Charge.	Potential in volts.	Internal Resistance. Ohms.	Work done in minutes.
10′	1·86	·59	20
20′	1·87	·59	53
30′	1·88	·59	85
40′	1·86	·60	52
50′	1·87	·60	73
60′	1·87	·60	87

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Two Cells joined in Multiple Arc.

10′	1·86	·54		26
20′	1·87	·54		40
30′	1·88	·54		45
40′	1·86	·56		43
50′	1·87	·56		59
60′	1·87	·56		72

It will be seen that the potential did not exceed 1·92 volts, and it could not be increased per cell, whatever the extent of surface, time of charging, or potential of the charging source might be. The internal resistance increases after successive charges over a short period of time, and its polarising capacity for currents appears to reach its maximum at the fiftieth minute, after which time it commences to fall rapidly. Can it be that in so short a time the minium becomes exhausted, and that the plates require to be recoated?

An ordinary Leclanché or Grove cell performed the same amount of work for 9,000 minutes, consequently I do not at the present time see the advantage of the secondary battery. The potential of an ordinary Grove cell is 1·94 volts, and 36 such cells are necessary to give a light equal to 29 candles by means of Swan's or other incandescent lamp.

In a secondary battery it is, I believe, impossible to obtain a higher potential than 1·92 volts; consequently, for a 29-candle-power light, 36 secondary batteries would be required. Therefore, I do not anticipate for these batteries the great future that was shadowed forth at York yesterday, and recorded in *The Times* of this morning.—Yours, &c.,

September 6th, 1881. Willoughby Smith.

AMERICAN PATENT EXAMINATIONS.

TO THE EDITOR OF THE ELECTRICIAN.

Edison and Sprague—Electric Meters.

Sir: When patent law is under consideration it is generally proposed that an examination as to novelty should be made, instead of patents being given to all comers, as is the English practice. Such an examination would be of great service to inventors in saving them from waste of time and money in re-inventing old discoveries. But it would not do to rely too much upon such official examinations. A little experience of my own will show that not only would it often be difficult to decide between the similarities of different inventors, but that examiners are fallible, and may overlook actual identity in two cases.

Some years ago I invented a meter for electricity for use by electro-platers, but finding that the varying resistances and electromotive forces rendered it not reliable, I set it aside and said nothing about it. When electric lighting appeared likely to become distributable, and that, consequently, a meter would probably be in demand, I returned to my old invention and patented it in November, 1878, and the subject being of interest in America, my patent rights have been purchased by the United States Electric Lighting Company, who proceeded to secure the American patent which I had left open under the American law, which maintains an inventor's right for two years after introduction.

But other inventors have also sought to devise a meter, and among them Mr. Edison, who took out a patent in October, 1880, for an apparatus which he calls a webermeter. That apparatus is identifical with my meter in principle, and only a modification of details in construction, and a comparison of the two descriptions will raise the question how it was possible for an examiner to pass Mr. Edison's claim for a patent in face of my invention of two years earlier date.

Mr. Edison's webermeter is described in *The Electrician*, Vol. vii., No 12, p. 191. It consists of two balanced metal plates in a solution of the metal, a reversing commutator and a registering system, and his general claim is (4) The combination of a decomposing cell, balanced polar plates therein, and registering apparatus and means for reversing the direction of the current through the cell, the register and reverser being controlled by the overloading of each plate, substantially as set forth.

My specification, 4,762, of 1878, says I employ those actions which result in a deposition of a metal in a solution of the same metal. I use two plates of the metal, and cause each to become alternately the anode when the other plate has lost so much weight as represents the unit of current employed, and I cause this change of direction in the current to be effected by the weight of metal passed from one plate to the other. This may be effected by various arrangements of apparatus. After describing one arrangement I go on to say these points and the armature constitute a reversing commutator, and other modes of effecting the purpose may be used. The motion of the armature is caused to move a ratchet wheel one tooth, and by this means to record in well-understood manner the number of reversals of current, each of which represents a definite quantity of electricity passing; the essential point of this portion of my invention being the production of motion in a set of wheels by the agency of plates of metal alternately dissolved and deposited on.

The question of the legal title to this invention of Mr. Edison and myself is now before the proper authorities in America; but the question of scientific priority is decided by my date of November, 1878, and Mr. Edison's date of October, 1880; and the fact that a legal question could arise in face of such dates conveys a warning to inventors.—Yours, &c., J. T. Sprague.

ELECTRIC LIGHTING.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I am obliged for the information respecting the cost of the "Brush" system, which, worked for 3,600 hours per year at 2d. per hour, would be £30 per annum per lamp. May I ask for further information? Gas lamps, of, say, 14 candle-power, are placed 50 yards apart in a circle of 25 yards radius, will an electric light of 2,000 candle-power illumine a circle 140 times the area of a gas lamp? and, if so, at what elevation should it be placed? If it will not extend its rays so far in practice as might be inferred from theory, how far apart should Brush lamps of that power be placed? In view of expense, one Brush light should supercede *ten* gas lamps.—Yours, &c. J. F.

Sept. 12, 1881.

TO THE EDITOR OF THE ELECTRICIAN.

PATIENCE, OR PERSEVERANCE REWARDED.

T. A. E's. Lament.

(Air obvious.)

When I first brought this little lamp out,
I gently remarked to myself,
Its one to a million
That every civilian,
Will lay his old lamp on the shelf.
Bright genius is praised everywhere,
And I've plenty of that—and to spare;
But inventors' professions,
Though often concessions,
Of snubbing have more than their share.
Which I never counted upon,
When I first turned this little lamp on.

I said when I first turned it on,
Its plain to the veriest dunce,
That all gas shareholders
Will shrug up their shoulders,
And sell off their gas shares at once.
I thought I was first in the Field,
And this lamp a good income would yield;
But my hopes are all blighted,
Completely benighted,
By a Briton whose plans were concealed.
Which I never counted upon,
When I first turned this little lamp on.

K. M.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

All communications to be addressed to 396, *Strand, London, W.C.*

We cannot undertake to return drawings or manuscripts, and must, therefore, request Correspondents to keep copies.

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ELECTRO-DYNAMIC TRANSMISSION OF POWER.

We need hardly say that we are as desirous as electricians generally that the applications of electricity to the transmission of power should be so extended that, on the one hand, power at present running to waste may be brought into use either for manufacturing or lighting purposes, or so that power produced from the present sources may be transmitted in such a manner and by such apparatus as to be applied with much more economy or facility. It is to be regretted, however, that many ideas now being spongily absorbed by the public, which have been put into their heads by insufficiently guarded statements made by eminent men at the British Association and other meetings, have been put forward in such glowing guise that they are calculated to do a great deal of harm. Expectations have already been raised which cannot be realised, and promises have been sown broadcast which will result in public investment in projects which electricians and engineers must know can only end in disappointment and loss. It might be said that it is not for us to concern ourselves with the wrong impressions acquired by the general public and insufficiently careful investors, but this is hardly the case, for it is as much the duty of *The Electrician* to tell the uninitiated that electricity is not likely to lessen the value of coal as a power-producing medium, or the value of the steam engine, as it was to tell the scared public nearly three years ago that the value of coal-gas producing and distributing works would long remain unaffected by the application of the electric light. It is our duty to prevent public discredit of electricians which must follow the statement made at York, if not contradicted, that the steam engine will soon become obsolete through the use of electro-dynamic machines, and also the statement made by a well-known, though recently-elected member of Parliament, that electricity will ultimately take the place of coal. It is quite unnecessary to tell electricians what view to take of these statements, but we must sometimes say a few words to those who are not electricians. There is, without doubt, as large a field for electricity as a power carrier as electricians can wish; but, except in a few instances, the applications of the electric motor will be new ones, and where neither steam nor gas engines can now be used without attendant objections, or where the trouble connected with their use more than outbalances the advantages derivable. For working small machines, at present worked by hand, and machines only occasionally in use, and for which it would not pay either to have steam constantly up in the boiler, or for the installation of a gas engine, and in some places where gas is not procurable at a low price, the electric motor will find a place. The cleanliness with which an electric motor can be used, the facility with which it can be put to work and its freedom from danger, will secure it hundreds of applications where power is required but cannot now be employed without some disadvantage. Electricity is not, however, a power in itself, as coal may be said to be. It has to be produced before it can be transmitted, and as a mode of motion it is not likely to supplant coal or the steam engine where coal is readily obtainable, and other sources of power easily available. For this reason, therefore, Sir W. Thomson and others have dwelt upon the use of tidal, river, and wind power as sources of power for the economical production of electricity for transmission to places where modes of motion are not economically or satisfactorily available. Sir W. Thomson somewhat summarily disposed of the proposal to make use of tidal power. He, however, based his calculations on the supposition that the reservoirs necessary for this purpose would be as costly as docks of the same area, and that the tide mills could only be made to work periodically. It must be remarked, however, that the number of places on our coasts where there is a considerably greater rise than the two metres, which he adopted, is not at all so limited as he would have us believe, and that tide water reservoirs need not cost anything like as much as docks. The heavy retaining walls would not be necessary, for in many places walls would not be required, as the earth could be excavated so as to leave the banks nearly at the angle of repose instead of nearly vertical as in a dock, and if the banks had an angle of say 40 degrees there are no places whereat anything more than a comparatively light wall would not suffice. Again, there are many existing marshes lower than the high tide level, and from which water is shut out by banks, and where reservoirs could be very cheaply made, as, for instance, at the site of the new deep water docks about to be constructed at Dagenham. These docks are, it is said, estimated to cost not more than about £10,000 per acre, and reservoirs at such a site could be constructed at not much more than half this sum. In our third volume we described an arrangement of reservoirs by which low pressure turbines could be made to work continuously by tidal waters, and, all things considered, there is sufficient reason for saying that the tides are not so hopeless a source of power as the President of the Physical Section seemed to think. With respect to river power it need only be remarked that almost every available site in this country has already its water mill of some kind. In other countries and in Ireland there is a good deal of water power not utilised, but in many of these, as in Ireland, this is not for want of means of utilising it, but for want of a market for the power either near or at reasonable distances from the water. Wind power may certainly be looked upon as a source of power by means of which many towns might be lighted by electricity and provided with power for many purposes. The Planté or other accumulator removes the objection which has been the chief cause of the decrease in the employment of wind power, namely, its irregularity. Sir W. Thomson looked upon the cheapening of windmills as the chief requisite for their extensive use in producing electricity. This must be left to the mechanical engineer, who will, no doubt, be able to sufficiently reduce their cost, but electricians have probably a more difficult task in reducing the cost of accumulation to a sufficiently low sum to make it possible to store cheaply at least four days' supply of electricity so that calms may not leave towns lighted by electricity in the dark.

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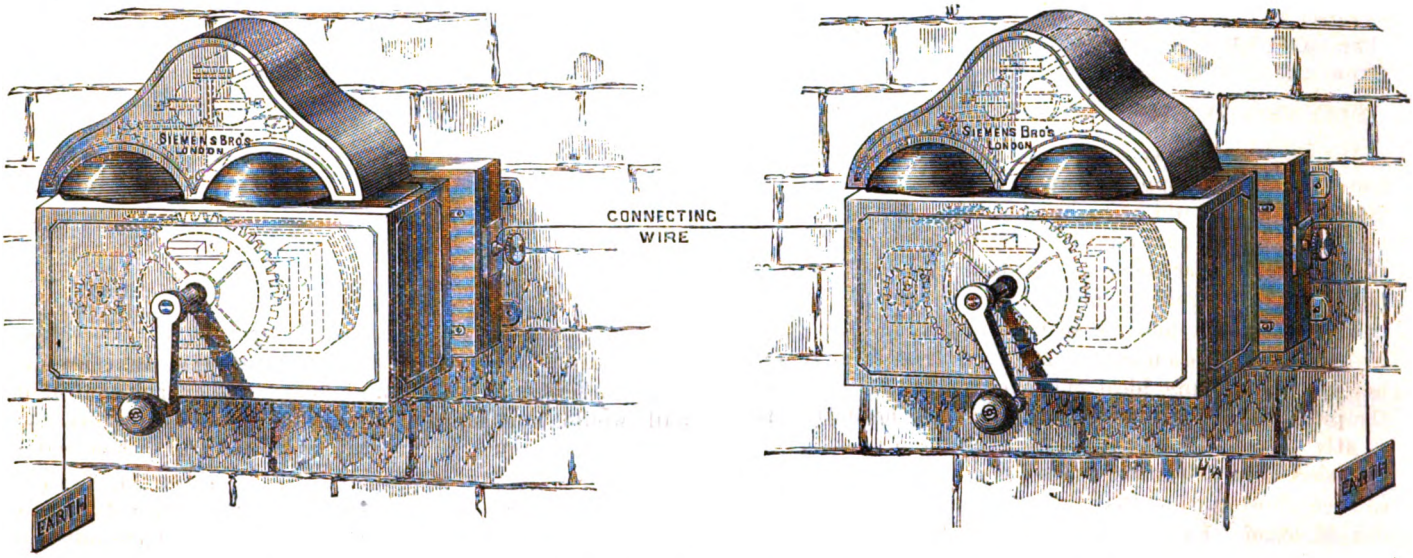
THE ELECTRICAL EXHIBITION AT PARIS.

Miscellaneous Exhibits.

Amongst the exhibits of Messrs. Siemens Bros. is their magneto-electric apparatus, by means of which bell signals can be transmitted between distant points. The object of the apparatus is to do away with the use of batteries which require more or less constant attention. Its construction is simple: it consists of a box containing a magneto inductor in combination with a powerful alarum of two bells, each four inches in diameter; the inductor contains six permanent magnets, shown by the dotted lines in the figures, between which a Siemens armature is made to revolve by means of a handle, thus generating currents which act on and ring the bells. The connections and construction of the apparatus will be easily understood on reference to the figures. The advantages of this system are that it is easily removed from one place to another, will stand a good deal of rough handling, and is always ready to be worked; it can be fixed against a wall as shown, or it can be fitted in a case for transport, occupying but very little space. To send a signal to the right hand bell, which we will suppose to be the distant station, it is only necessary to turn the handle of the left hand apparatus, or home station.



Winter's Single Line Block Apparatus.

In England, where most of the railways are double lines, inventors have striven to produce instruments for signalling on the block system which should be applicable to double lines, while the requirements of single lines have been comparatively neglected. In India, however, and the colonies generally, where the traffic is not great, the railways are mostly single lines, and the English methods are, therefore, unsuitable. Owing to the great length of the Indian single lines, the staff and ticket mode of working does not answer, and railway managers in India are generally of opinion that, provided the block system is carefully carried out, nothing more is necessary to ensure a safe and proper regulation of the traffic. Whenever the block system has been introduced on Indian railways, crossing orders have been discontinued, and practically speaking, a train is allowed to run from station to station without regard to the "meeting" stations as laid down in the time table, so long as the block instruments indicate the line clear. Certain regulations are in force for giving preference to mail and express trains, but as a rule, the first which comes is first served.

It is evident, therefore, that when the block system is solely employed in this way, it is saddled with a responsibility which does not rest upon it when, as in England, it is used merely as an auxiliary to either the crossing order or the staff and ticket system, and it has been the aim of Mr. G. Kift Winter, telegraph engineer of the Madras Railway, to produce a block apparatus which shall answer all demands upon it.

The semaphore instruments of Mr. Preece are admirably adapted for double line working, and, having the important advantage of requiring the conjoint action of the signalmen at each end of a block section to remove the danger signal, they have been introduced into the Great Indian Peninsula, Bombay, Baroda, and Central India, and some other Indian lines; but they have the defect of not showing the direction in which a train is going, and for working single lines this knowledge is important. As used on one line they do not even show whether a train is on the section or not. For a single line the instruments should indicate clearly not only whether the section is clear or blocked, but, if blocked, they should tell whether the train is approaching the station in question or leaving it, and bear a permanent record of the fact, for experience shows that no reliance can be placed on the memory of signalmen or mere entries made in the signal book. It is of the first importance to have the fact before one's eyes that station A has given "line clear" to B, or *vice versâ;* because it may often happen that a train at A is ready to start for B at the same time that a train at B is ready to start for A; and since one must wait for the other, it should be clearly understood and recorded by the instrument itself which train may be allowed to start and which is to be kept back.

Further, it is desirable that neither signalmen acting alone should be able to alter in any way the indications of either instrument, but that such alteration should be made by the joint action of the two signalmen at both ends of this section. It has, as Mr. Winter observes, been generally recognised that a signalman should not be able to alter the indication of his own instrument; but it is equally important that he should be unable to alter those of the distant instrument without the knowledge and concurrence of the distant signalman. It is also important to guard against any false electric current, due either to lightning or accidental contact between two wires, being able to alter the indications of the instrument.

Mr. Winter's apparatus was, as we have said, designed to fulfil these requirements in working the single lines of India, but with suitable modifications it can likewise be adapted to the double lines of this country. It consists of an indicator, shown in Figs. 4 and 5, having two dials and two pointers. One pointer (the left) is painted red, and refers to trains approaching the station. The other needle (the right) is painted black, and refers to trains leaving the station. Each needle has two positions, namely, "cleared" and "on line." Underneath the red needle are the words, "train coming from," and underneath the black are the words "trains going to," while the name of the station with which the instrument is connected is placed below to complete each sentence. The indicator is also provided with a "plunger" handle, A, to

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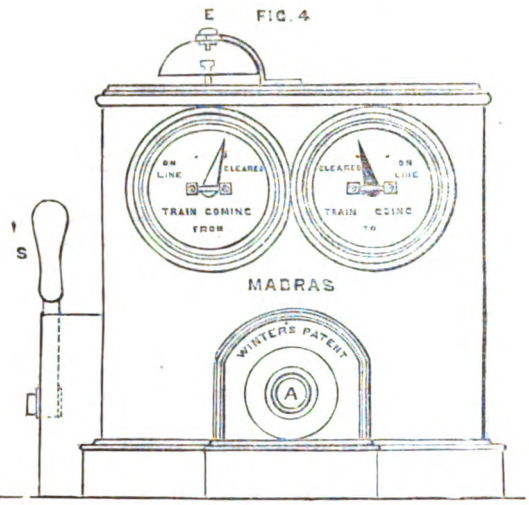
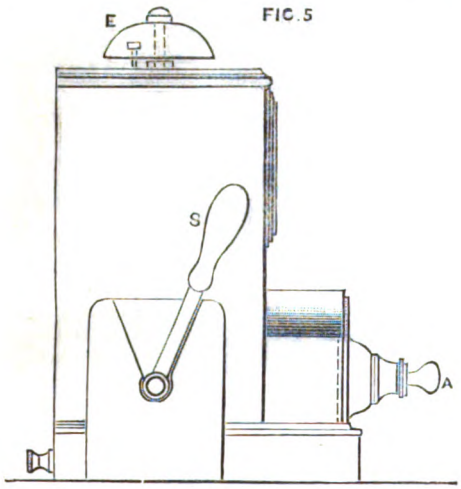
give signals to the distant station, a bell, E, on the top for receiving the signals from the distant station, and a switch

FIG. 4



handle, S, which, provided an acknowledgment be obtained from the distant signalman, controls the "train coming"

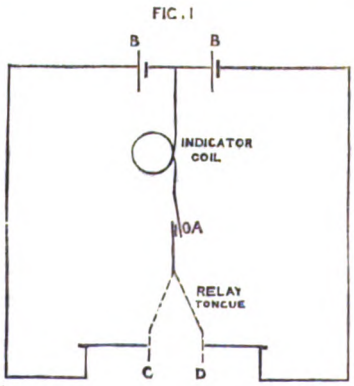
FIG. 5



pointer of the near station, and the "train going" pointer of the distant one.

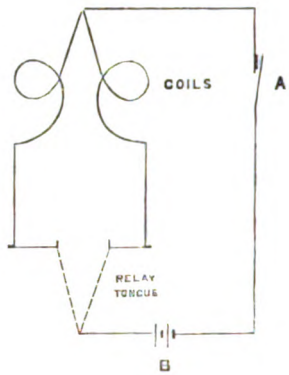
The needles are deflected from one position to another by means of electro-magnets in circuit with a local battery, and to allow this battery to act the local circuit must be closed. This is done partly by the tongue of a polarised relay and partly by another relay. In order to move either of the needles to right

FIG. 1



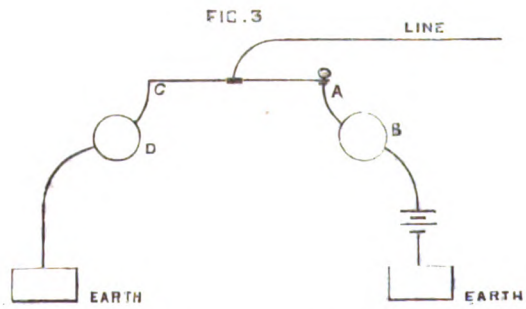
or left the tongue of the polarised relay must be moved from right to left, so as to reverse the direction in which the local current shall flow through the indicator coils. This reversal may be effected by making the relay reverse the poles of the local battery, as shown in Fig. 1, where B B are two equal parts of the battery connected by opposite poles to the relay tongue, which, according as it is in the position *c* or *d*, is ready to send positive or negative currents through the indicator coil. We say "is ready" to send these currents, for, with a view to secure the combined action of the two signalmen, Mr. Winter has arranged that the local circuit shall not be completely closed by the polarised relay alone, but by the action of that relay and a second relay, A, which is actuated by the other signalman. Hence both signalmen are necessary to alter the position of a needle, one changes the *direction* of the local current in the indicator coils, and the other bids it flow. Another way of reversing the local current in the coils is to wind them differentially round the needle and make the polarised relay tongue send the current through one branch or the other, as shown in Fig. 2, where the lettering is as in Fig. 1.

FIG. 2



The general arrangement of the indicators is explained by Fig. 3. Let A be a key or "plunger" of the ordinary form, having the line wire brought to its middle terminal. Then, if the polarised relay for reversing the direction of the train-going indicator be placed at D, between the back contact of the key, which is always closed when the key is left at rest, and the earth, it is evident that the signalman at the distant station will be able to send a current to actuate the relay and reverse the pole. But he will not be able thereby to close the local circuit. This can only be done by the relay B, which operates when contact is made with the plunger at A by the new signalman. Thus, the reversing relay D is placed under the control of the distant signalman, and the relay B, which completes the local circuit and deflects the "train going" indicator needle, is under the control of the

FIG. 3



near signalman himself. In like manner, if the polarised relay for controlling the direction of the local current acting on the "train coming" needle be placed at B, and the relay for closing the circuit be placed at D, the combined action of the signalmen at the ends of the section is required to move the "train coming" indicator.

By this arrangement no signal is completed until it has been acknowledged. For example, suppose a train has to leave A for B. It is not enough that B should give line clear to A, but it is also necessary that A should acknowledge this signal before the instrument at A will indicate that a train is "going to B," and the instrument at B will indicate that a train is "coming from A." In the same way, when the train arrives at B, the arrival signal must be given by B and

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acknowledged by A before the instruments will indicate that the train has "cleared" the section.

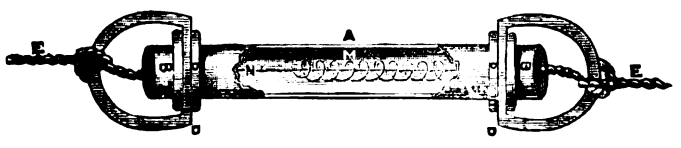
One drawback in all block instruments is the fact that the station-master may neglect the instrument altogether, and allow a train to leave without previously obtaining the "line clear" signal from the next station; but to prevent this contingency it has been found advisable to call in the aid of a starting semaphore placed outside the signal cabin in a position easily seen by the driver of the train prior to his leaving the station. This semaphore is ingeniously worked in connection with the block instruments in such a way that the danger arm cannot be lowered to allow a train to leave until the "line clear" signal has been received from the next station. Moreover, the arm is raised to danger automatically by the train itself on entering the section.

Space will not allow us to describe in detail the mechanism of this semaphore and its connection with the block instruments. Suffice it to say that when the arm is put to danger it is held in that position by means of an electric lock, which can only be liberated by the "line clear" signal from the distant station, and by a counterpoise which is under the control of the signalman in charge of the semaphore, and must be raised by him to give the "all right" signal. The train, on entering the block section and passing the signal, again raises it to "danger" by the flange of one of the front wheels pressing down a cranked cam jointed to a jaw of one of the chairs carrying the rails, and thereby pulling a connecting rod which withdraws the support of counterpoise and elevates the arm.

The arrangement of the starting semaphore is partly due to Mr. James Craik, assistant traffic manager of the Madras Railway Company. The combined apparatus is exhibited at the Paris Electrical Exhibition by Messrs. Latimer Clark, Muirhead, and Co., telegraph engineers, Westminster. Although specially designed for single lines, Mr. Winter's apparatus is, as we have said, quite applicable to the working of double lines. For operating these on the "affirmative" system, in which the normal position of the arm is at danger, no change would require to be made in the instruments; while for the positive system, in which the normal position of the arm is at clear, a simple modification of the apparatus is all that is required. Judging by its success on the Madras Railway, the new block apparatus has a promising career before it.

TELEGRAPHIC COMMUNICATION WITH LIGHT-SHIPS.

The object of this invention—the design of Mr. Thomas Moore, of 54, Gracechurch-street—is to enable an electric cable, when attached to a light vessel off the coast, to revolve and to prevent a kink being formed in the cable. The metallic tube A receives the telegraph wire at either end. The mouth pieces B B are inserted into the tube, the swivel having previously been placed into position against the shoulder D. The mouth piece screws into the tube, and is fitted with a stuffing box packed with india rubber. The



cable E E is fastened to the swivels, and on entering the mouth piece is made smooth to allow of its revolving. On the wire passing from the stuffing box into the tube the covering is taken off and one end is formed spirally, M, and the other—or straight end—N, goes through the middle of the helix. The two ends of the wire for a certain length are brought into contact, but not fastened. The cable at one end or both can revolve and the electric current is sustained. No water can get into the tube. This appliance can be fitted on board of a vessel, or in the sea, to the telegraphic wire. The tube would also, so applied, take off the pressure on cables .a d on rough ground and in strong tides.

ELECTRIC LIGHTING BY INCANDESCENCE.*

BY J. SWAN.

Ever since Sir H. Davy showed that a brilliant and continuous light could be produced by causing the current from a voltaic battery to pass between two points of charcoal, the application of electric light to useful purposes has been one of the chief aims of electrical experimentalists. But it is within the last twenty years, or since mechanicians and electricians combined to make it possible to produce electricity by mechanical means, that the idea of useful electric illumination has been brought within the scope of practicality.

The difficulty of producing electric light with carbon points was to make it steady, and to moderate its excessive brilliance. By dint of improvements in the form and quality of charcoal points, and ingenious mechanism for maintaining the points of these pencils at a constant distance from each other, the first of these difficulties has, to a very large extent, been overcome. But the second one has remained, and from the very nature of the case must remain, as an insuperable obstacle to the application of this form of electric light to the general purposes of artificial illumination.

I do not intend to convey the opinion that the form of electric light to which I am referring is not in some cases a useful form. It would be absurd to express such an opinion in the presence of those who have witnessed the splendid illumination of the railway stations and streets of London, and by these means.

What I say is this, that that form of electric light is only exceptionally applicable; that it leaves the greater number and the more important of our wants in respect of artificial light unprovided for. It is, in my opinion, quite inapplicable to domestic lighting, and it is there that we experience the most keenly the evils of the existing modes of artificial illumination by means of gas and oil lamps. In order to adapt electric light to house illumination it is necessary to entirely change the method of producing it.

Starr was the first to conceive the idea that it might be possible to produce an electric light both small and steady by heating to a white heat a thin piece of carbon. Starr's proposal was to put a thin plate of carbon in the vacuum of a mercury barometer, and to keep it in a state of white heat by passing an electric current through it.

The difference between the two systems I have mentioned is this—in the first in which light is produced by a disruptive electric discharge between points of carbon there is a break in the circuit so far as solid material is concerned at the place where the light occurs.

In the other, the solid conductor is quite continuous, but at the place where light is produced the conductor has a high degree of resistance. At that place the conductor is carbon, and as carbon is comparatively with metals a bad conductor, it happens that when an electric current is forced through this circuit a certain amount of electricity is converted into heat in the carbon. If the quantity which passes in a given time is large enough in proportion to the mass of carbon it becomes white hot and emits light.

Electric light produced on this principle of incandescence has many good properties which electric light produced by the disruptive discharge between carbon points, commonly known as the "arc," has not.

If the electric current which produces the incandescence is quite constant, the light emitted by the white hot carbon is absolutely constant. There is not the slightest flicker or variation in it; it is, moreover, quite under control as to its brilliance, and may be made as yellow as gaslight, or as white almost as sunlight. It communicates no noxious vapours to the air, and it is not too costly.

But the crowning merit of electric light produced on the principle of incandescence is that it is indefinitely divisible without sacrifice of economy. You may have a lamp so constructed as to give a light of ten candles, or you may construct it with larger conductors so as to obtain a light of 100 candles from your incandescent carbon, and the smaller lamp will be almost as economical as the larger—light for light. That is, the ten-candle lamp will only use $\frac{1}{10}$th of the power, and, therefore, cost $\frac{1}{10}$th of the amount to maintain it, that is required by the lamp which gives ten times the light.

This property of divisibility into as many small centres of illumination as are required—which is inherent to this method of electric lighting by incandescence to fully the same extent as in gas light—combined with the steadiness of this species of light, its good colour, and its wholesomeness, give it a character of general applicability which is not possessed by any other kind of electric light. It is 40 years since Starr, through his agent, King, took out his patent for producing light on this principle.

* A paper read before the British Association, York Meeting.

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It is only within the last two or three years that the many practical difficulties that beset the utilisation of this method have been surmounted. Nothing can well be simpler than the ideal incandescent lamp. A slip of carbon in a vacuum, that is all. To realise this idea much experimentation had to be gone through and much disappointment to be suffered.

Starr did not make his lamp practical. Lodyguine, Koun, and Sawyer and Mann tried long and patiently to render it practical, but they did not quite succeed.

The first difficulty was with the vacuum. In the vacuum lamps of earlier date it was neither possible to produce nor to maintain a perfect vacuum, there were always screws and washers about them, and these, and the carbon itself in a cold state, formed a reservoir of air quite sufficient to cause the disintegration and rupture of the carbon after a few hours' ignition. Besides this difficulty of the carbon soon breaking, there was a further difficulty in the blackening of the glass enclosed.

From elaborate experiments made by M. Fontaine, and published in his work on electric lighting, the conclusion was arrived at that the blackening of the lamp bells was due to the volatilisation of C, and that the breakage was also a consequence of this action, objections, if valid, quite final to the practicability of this method. In short, at the period of these experiments, four or five years ago, electric lighting by the incandescence of C in vacuo was completely discredited by the crudity of all the attempts that had been made to apply the principle, and by the fallacies which had grown out of these unsuccessful attempts, and which obtained general acceptance, so much so that in the report of the Select Committee of the House of Commons on Electric Lighting, issued June, 1879, and in connection with which evidence was given by all the highest electrical authorities of that time, there is no mention whatever even of the possibility of producing light in this way.

I saw reason for doubting the soundness of M. Fontaine's conclusions with respect to the cause of the breakage of the carbons in incandescent lamps, and years ago I proceeded to test them by experiment. My main idea was to employ in a good Sprengel pump vacuum a form of carbon made by carbonising paper at a high temperature, with which I had experimented many years before. By means of this form of carbon I hoped to obtain economy in the light, because as it was very thin, a small current would make a strip of it white hot.

The carrying out of my idea was made easy by the assistance I received from Mr. Stearn.

Mr. Stearn undertook to mount some of my paper carbons in a good vacuum, and after many failures from carbons breaking, he at last succeeded in making some bulbs, very highly exhausted, contain my paper carbons attached by electrically deposited copper to platinised strips, which carried the current in and out of the lamp.

I had the pleasure in February, 1879, of showing to the President of this Section (Sir W. Thomson) a lamp made in this way. In making these experiments I did not confine myself exclusively to the use of paper carbon. The lamp, as constructed for me by Mr. Stearn was extremely simple. It consisted merely of a highly exhausted glass bulb into which were sealed, by fusion of the glass, two platinum conductors supporting the carbon.

This simple form of lamp I showed lighted at a lecture which I delivered before the Philosophical Society of Newcastle, in February, 1879. The final result of our experiments was, that when the vacuum was good the carbon did not appreciably wear away, and that when the contact between the ends of the carbon and the metallic conductors was good, the globes did not blacken. Henceforth it was possible to produce a durable electric lamp that emitted a steady light of moderate power.

Very soon after this, and I am quite sure without knowing what I was doing, Mr. Edison produced a lamp identical with mine in all essential particulars. It, too, consisted of a simple bulb, from which the air had been exhausted by the Sprengel pump, and which like mine had no screw-closed openings, nor complications of any kind, but contained simply the in-going and out-coming wires sealed into the glass with the carbon attached to them.

Since then, the manufacture of lamps on this principle, with slight modifications in the material out of which the carbons is made, and the manner of making it, has been established on an extensive scale, both in England and America, and in the electrical exhibition now open in Paris, electric light produced by incandescence occupies an important position. Already in this country the method has been put to actual use in house illumination, and for lighting the saloons of passenger steamers. It has also been tried experimentally in coal mines.

The success which has attended these applications is such as to render the subject one of great interest to mechanical engineers, for until that great discovery is made of the possibility of which the President has spoken in his inaugural address, when electricity shall be produced by direct conversion of heat into electricity with smaller loss of energy than is involved in its conversion into motive power through steam, until that revolutionary change is made, we shall have to look, perhaps, not entirely but mainly to motive power, and to mechanical engineers for the apparatus wherewith to produce the electricity required for electric lighting.

Here is a view of one of my lamps. Here is the bulb of glass made as nearly as possible vacuous. Here are the wires which carry the current in and out of the lamp through the carbon, which is here. The carbon is made from cotton thread treated with sulphuric acid, and then carbonised at a high temperature out of contact with air. Here is a piece of paper which has been treated by the process I have mentioned, and here is a piece of the paper before treatment. You will observe that the treatment has welded the fibre together. The difference in the carbon produced from the treated and the untreated paper is as great as the difference in the paper before carbonisation. Let fall on some hard surface, this carbonised parchment paper rings like metal, while the carbonised blotting paper is soft and porous. An additional advantage of this process of parchmentisation is that it facilitates the thickening of the ends of the carbon filament where good and extensive contact with the metal conductor is essential. Carbon made in this way is hard and elastic to a degree quite wonderful. Filaments ·01in. diameter and 2 or 3in. long can be bent double, and on release, spring back like steel. After being heated for some time to an extreme temperature by the electric current, the carbon develops qualities of hardness and incombustibility which place it in an altogether exceptional position, and which give promise of great durability for incandescent lamps.

The hardening process is accompanied by a change in conductivity, the carbon in its hardened condition offering less resistance to the passage of the electric current than before. This at first sight may seem to be a disadvantage, inasmuch as the intensity of light depends on the amount of heat developed in a given mass, and this reduction in the resistance of a given filament implies a lower temperature and less light for a given current passing, but this is compensated by the less electromotive force required to overcome the resistance. To develop the same temperature and light in the extremely hard form of carbon which I have aimed at producing more current and less E.M.F. are required, as the two are equivalent to each other. There is no loss of economy by this change of condition, and mechanically there is an advantage, for the harder C is less liable to rupture. It is, in fact, more nearly in a state of utmost consolidation and stability. The amount of light that can be obtained from one of my lamps obviously depends on the superficial area of the C, and the temperature to which it is heated, but the amount of light emitted by a hot body increases in a greater degree than the temperature. Evidently, therefore, the hotter it can be made the better for economy.

By sending enough current through the carbon its temperature can be raised to such a point as produces a light rivalling in intensity the arc light. So much as 500-candle light has been obtained from one of my small lamps when pushed to its utmost limit of endurance, but the lamps are not durable at the enormously high temperature that produces this light. The lamp that would, if pressed with current to the breaking point, give a light of 500 candles, would be durable while giving a light of 50 candles.

A very much larger return of light for power expended can be obtained if the durability of the lamp is disregarded than if durability is considered. Sir W. Thomson and Mr. Bottomly have made careful measurements of the energy expended in the production of light in my lamps. Some of their results are shown in this table, from which it appears that with one of my small lamps, when rather less than 1·6 h.-p. was expended on it, a light of 42 candles was emitted, or an aggregate of 270 candles per h.-p. With a higher E.M.F., and therefore a larger current, 102-candle light was obtained from the same lamp. This amount of light was produced by the expenditure of rather more than ¼ h.-p., *i.e.*, the h.-p. under these circumstances yielded 390 candles.

By producing light in this manner, and employing the gas engine as the motor to drive a dynamo-electric machine, the very interesting result is arrived at that more light is obtained from a given quantity of gas exploded in the gas engine than can be obtained in the usual way to produce the light directly.

An important point in this method of illumination, and one of particular interest to engineers, is the necessity for regularity of speed in the motor, unless some regulating device, such as a secondary battery, intervene between the dynamo-machine and the lamps. Without such assistance the slightest irregularity in the speed of the dynamo makes itself apparent in the fluctuation

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of the light. The light is so sensitive to variations of speed that the overlap of a driving belt is quite sufficient to make the light wink at every passage of the joint over the pulley.

But I do not apprehend a continuance of this slight difficulty, for it is quite certain that the secondary battery, in which so great an improvement has recently been made by M. Faure, used in the manner described by Sir W. Thomson on Friday last, will come into use, to do away with it entirely, and at the same time do away with many other difficulties and inconveniences of supplying current to lamps directly from the dynamo-electric machine.

The extremely rapid alterations of direction which occur when incandescent lamps are lighted by alternating current machines do not produce any unsteadiness in the light. The lamps which have been kept lighted during several nights past in one of the picture galleries of the exhibition here, and which some of you have probably seen, are worked by Siemens's alternating current machine. You would notice they have been perfectly steady. It is a question which time alone can answer whether the lamps will prove more durable with an alternating or with a continuous current. There is, perhaps, some slight ground for surmise that they will last longer with the alternating current.

Referring back for a moment to the use of my lamps in mines. So far the mine lamp, defended by a suitable lantern, has been detached by flexible conducting wires to main conductors. The limited portability this arrangement allows is inconvenient, and the main conductors are expensive, and their retention does not permit the total elimination of the element of danger in connection with the accidental breakage of a wire. I have, therefore, thought that a completely self-contained and portable mining lamp would be an advantage, and I have here a specimen of such a lamp, for the construction of which I am indebted to the skill of M. Gimmingham. This lamp can be kept lighted for six hours by two cells of Faure's secondary battery, weighing 10lb, and will give the light of one or two candles during that time. To charge the battery afresh it will only be necessary to place it for a time in connection with the wires of a dynamo near the pit's mouth. The lamp and its attached battery need never come out of the pit.

Now that we can look to the method of electric lighting by incandescence as a perfectly practicable method, and now that we have the means of combining the economy of the mechanical generation of electricity with the constancy and many conveniences of voltaic accumulation, it is clear that the time is now ripe for the almost unlimited application of electric light to general purposes, and that engineers may, with much advantage, give their immediate attention to the many details which fall within their province in connection with the mechanical production and distribution of electricity on a large scale.

ON SOME APPLICATIONS OF ELECTRIC ENERGY TO HORTICULTURAL AND AGRICULTURAL PURPOSES.*

BY C. WM. SIEMENS, D.C.L., LL.D., F.R.S., MEM. INST. C.E.

(CONTINUED FROM PAGE 270.)

I am aware that the great weight of the opinion of Mr. Darwin goes in favour of the view that many plants, if not all of them, require diurnal rest for their normal development, and it is with great diffidence, and without wishing to generalise, that I feel bound to state, as the result of all my experiments, extending now over two winters, that although periodic darkness evidently favours growth in the sense of elongating the stalks of plants, the continuous stimulus of light appears favourable for healthy development at a greatly accelerated pace through all the stages of the annual life of the plant, from the early leaf to the ripened fruit. The latter is superior in size, in aroma, and in colour, to that produced by alternating light, and the resulting seeds are not at any rate devoid of regerminating power.

Further experiments are necessary, I am aware, before it would be safe to generalise; nor does this question of diurnal rest in any way bear upon that of annual or winter rest, which probably most plants that are not so-called annuals do require.

The beneficial influence of the electric light has been very manifest upon a banana palm, which at two periods of its existence, viz., during its early growth, and at the time of the fruit development, was placed (in February and March of 1880 and 1881) under the night action of one of the electric lights set behind glass at a distance not exceeding two yards from the plant; the result was a bunch of fruit weighing 75lbs., each banana being of unusual size, and pronounced by competent judges to be unsurpassed in flavour. Melons, also remarkable for size and aromatic flavour, have been produced under the influence of continous light in the early spring of 1880 and 1881, and I am confident that still better results may be realised when the best conditions of temperature and of proximity to the electric light have been thoroughly investigated.

My object hitherto has rather been to ascertain the general conditions necessary to promote growth by the aid of electric light than to the production of quantitative results, but I am disposed to think that the time is not far distant when the electric light will be found a valuable adjunct to the means at the disposal of the horticulturist in making him really independent of climate and season, and furnishing him with a power of producing new varieties.

Before electro-horticulture can be entertained as a practical process it would be necessary, however, to prove its cost, and my experiments of last winter have been in part directed towards that object. Where water power is available the electric light can be produced at an extremely moderate cost, comprising carbon electrodes, wear and tear of and interest upon apparatus and machinery employed, which experience elsewhere has already shown to amount to sixpence per hour for a light of 5,000 candles. The personal current attention requisite in that case consists simply in replacing the carbon-electrodes every six or eight hours, which can be done without appreciable expense by the under gardener in charge of the fires of the green houses.

In my case no natural source of power was available, and a steam engine had to be resorted to. The engine of six nominal horse-power which I employ to work the two electric lights of 5,000 candle-power each, consumes 56lb. of coal per hour (the engine being of the ordinary high-pressure type), which, taken at 20s. a ton, would amount to 6d., or to 3d. per light of 5,000 candles. But against this expenditure has to be placed the saving of fuel effected in suppressing the stoves for heating the green houses, the amount of which I have not been able to ascertain accurately, but it may safely be taken at 2s. 3d. reduction of the cost of coal for the engine, thus reducing the cost of the fuel per light to 1d. per hour. The total cost per light of 5,000 candles will thus amount to 6d. + 1d. = 7d. per hour.

This calculation would hold good if the electric light and engine power were required during, say, twelve hours *per diem*; but inasmuch as the light is not required during the daytime, and the firing of the boiler has, nevertheless, to be kept up in order to supply heat to the green houses, it appears that during the daytime an amount of motive power is lost equal to that employed during the night.

In order to utilise this power I have devised means of working the dynamo-machine also during the day time, and of transmitting the electric energy thus produced by means of wires to different points of the farm where such operations as chaff-cutting, swede-slicing, timber-sawing, and water pumping have to be performed.

These objects are accomplished by means of small dynamo machines placed at the points where power is required for these various purposes, and which are in metallic connection with the current-generating dynamo-machine near the engine. The connecting wires employed consist each of a naked strand of copper wire, supported on wooden poles or on trees, without the use of insulators, whilst the return circuit is effected through the park railing or wire fencing of the place, which is connected with both transmitting and working machines by means of short pieces of connecting wire. In order to insure the metallic continuity of the wire fencing, care has to be taken, wherever there are gates, to solder a piece of wire, buried below the gate, to the wire fencing on either side.

As regards pumping the water, a 3 horse-power steam engine was originally used, working two force pumps of 3½in. diameter, making 36 double strokes per minute. The same pumps are still employed, being now worked by a dynamo-machine weighing 4 cwt. When the cisterns at the house, the gardens, and the farm require filling, the pumps are started by simply turning the commutator at the engine-station, and in like manner the mechanical operations of the farm already referred to are accomplished by one and the same prime mover.

It would be difficult in this instance to state accurately the percentage of power actually received at the distant station, but in trying the same machines under similar circumstances of resistance with the aid of dynamometers as much as 60 per cent. has been realised.

In conclusion, I have pleasure to state that the working of the electric light and transmission of power for the various operations just named are entirely under the charge of my head gardener, Mr. Buchanan, assisted by the ordinary staff of under gardeners and field labourers, who probably never before heard of the power of electricity.

Electric transmission of power may eventually be applied also to thrashing, reaping, and ploughing. These objects are at the

* Paper read at the British Association.

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present time accomplished to a large extent by means of portable steam engines, a class of engine which has attained a high degree of perfection, but the electric motor presents the great advantage of lightness, its weight per horse-power being only 2 cwt., whilst the weight of a portable engine with its boiler filled with water may be taken at 15 cwt. per horse-power. Moreover, the portable engine requires a continuous supply of water and fuel, and involves skilled labour in the field, whilst the electrical engine receives its food through the wire (or a light rail upon which it may be made to move about) from the central station, where power can be produced at a cheaper rate of expenditure for fuel and labour than in the field. The use of secondary batteries may also be resorted to with advantage to store electrical energy when it cannot be utilised.

In thus accomplishing the work of a farm from a central power station considerable saving of plant and labour may be effected. The engine power will be chiefly required for day work, and its night work for the purpose of electro-horticulture will be a secondary utilisation of the establishment, involving little extra expense. At the same time the means are provided of lighting the hall and shrubberies in the most perfect manner, and of producing effects in landscape gardening that are strikingly beautiful.

THE ELECTRIC DISCHARGE THROUGH COLZA OIL.*

BY A. MACFARLANE, D.SC., F.R.S.E.

The electric properties of colza oil which I have examined are its dielectric strength and some phenomena which accompany the passage of the spark. By the dielectric strength of a substance I mean the ratio of the difference of potential required to pass a spark through the substance to that required to pass a spark through air under the same conditions. The electrodes used were two parallel brass plates each 4 inches in diameter. When comparing the gases the standard distance of the plates chosen was 5mm. In the case of liquids it is convenient to observe for a shorter distance, and reduce the result by the law which previous experiments of mine have established, namely, that in the case of the discharge between parallel plates through a liquid dielectric the difference of potential required is proportional to the distance between the plates. (*Trans. R.S.E*, vol. xxix., p. 563). One set of observations gave the ratio for colza oil to be 2·7; another gave 2·5. Hence 2·6 may be taken. I have now obtained the following table of dielectric strengths for liquids (air being unity):—

Substance.	Dielectric strength.
Paraffin oil	3·7
Oil of turpentine	4·0
Paraffin (liquefied)	2·4
Olive oil	3·5
Colza oil	2·6

The specific gravity of the colza oil is ·91.

The passage of the spark was accompanied by the formation of gas bubbles, but there was no deposition of solid particles. As the 4in. plates were placed horizontally in the oil, a bubble produced by a discharge was prevented from escaping by the upper plate. When the upper plate is again electrified, such a bubble behaves in the following manner:—If it is large enough it will extend itself somewhat like an hour glass between the plates, but if it is smaller it takes the form of an acorn with a flat base, the base resting on one or other of the plates. When the upper plate is charged positively, the bubble is repelled so as to place its base on the lower plate; when the electricity is changed to negative the bubble remains with its base on the upper plate. A reversal of the order of the charging did not change the effect. After a few electrifications a sufficient number of solid particles collects to form a chain, and this interferes with the phenomenon, the bubbles then being lengthened out in a remarkable manner, but never repelled to the lower plate. When the upper plate was charged negatively, gas bubbles appeared to me to rise from the lower plate, as if they had been formed there. To test this point further I took some sparks between two smaller discs placed vertically in the oil. The gas bubbles were observed to rise up at the negative surface, as if they had been formed at the positive surface, had been repelled or carried straight across and then rose up at the negative surface. When the spark was taken between two points bent at right angles to two rods dipping into the oil the bubbles were observed to shoot out in the direction from the positively charged point, and to circulate round the earth-rod some time before rising to the surface. These phenomena indicate that the bubble is positively electrified.

* A Paper read at the British Association.

CANTOR LECTURES.*

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

BY PROFESSOR W. GRYLLS ADAMS, F.R.S.

(CONTINUED FROM PAGE 252.)

LECTURE II.—DELIVERED MONDAY, MARCH 14, 1881.

The measurement of electric currents.—Efficiency of magneto and dynamo electric machines.—Heating effects of the current.

After the discovery of the principles which I explained in the last lecture, and the method of producing currents of electricity by the inductive action of magnets, or currents in motion, the laws of these currents were being developed; but, for twenty years after Faraday's discovery in 1831 that the sudden removal of a coil of wire from the pole of a magnet gave rise to a current, nothing was done to apply these laws for the purposes of electric lighting. Voltaic batteries were being improved, and the more constant and more powerful batteries of Daniell, and Grove, and Bunsen were discovered, and these were the sources employed to produce the more powerful currents of electricity. In this country Grove's battery was the favourite; and in our laboratories we may say that, up to the present time, the 40 or 50 cells of Grove have always been used to give us the electric light.

When used for optical experiments in the laboratory, the source of light should be as steady as possible, and as the carbons burn away their points should be continually brought to the same position; hence the elaborate arrangements of wheel work and electro-magnets devised by Staite, in 1847, and by Foucault, which have reached very great perfection in the hands of Duboscq.

One of the carbons, that connected with the positive pole of the battery, burns away twice as fast as the other, and hence the wheel work must be adapted for feeding these carbons automatically at the proper rate.

When the current flows always in the same direction in the arc, as in this case where Grove's battery is used, and in all cases where the magneto machine is adapted for producing continuous currents, the positive charcoal point or carbon becomes hollow, and wears away more rapidly; and the negative carbon becomes pointed, and wears away about half as fast.

In the Duboscq lamp the positions of the points of the carbon are kept as nearly as possible the same; the carbons are moved towards one another by means of a drum carrying two wheels, whose diameters are as two to one, which move two racks, which carry the carbons towards one another. This lamp is far too complicated and delicate in its mechanism to use with magneto-electric machines, and therefore the system adopted in it, for regulating the current and regulating the carbons, requires considerable modification before this lamp can be adapted for general use for the purposes of electric lighting. It is especially adapted for use with optical apparatus, and for showing by projection on the screen the special characteristics of the arc formed by the glowing gases of various substances. We may use it now for showing the character of the arc formed by silver converted into a glowing gas by the intense heat of the arc. This arc shows us that silver is rich in the violet or chemical rays, and points to the reason why the salts of silver are of so much use in photography.

ELECTRIC REGULATORS OR GOVERNORS.

By the laws of Ohm we get the relation between the electromotive force, the current, and the resistance expressed by the statement:—

The product of the current by the resistance in a circuit is equal to the electromotive force in that circuit, or $E = C(R + r)$.

Regulators may act so as to control—

1. The electromotive force and internal resistance of the battery or dynamo-electric machine.
2. Or they may control the useful resistance in the circuit.
3. Or they may control the external resistance, which does not produce useful work.

Regulators which control the current by altering the electromotive force or internal resistance of the source of electricity, so as to counterbalance other distributing effects, are not practically of much importance, and so need not detain us long. Suppose, for instance, that an increase of current acted on a rotating governor in such a way as to raise the plates out of the battery, thereby increasing the internal resistance, this would diminish the currents which would so react on the governor, and again lower the plates. Or suppose the current passes round a coil which is set with its axis vertical, and that an iron rod

* Reprinted from the *Journal* of the Society of Arts for August, 1881.

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supports the carbon and zinc in a bichromate of potash battery, and passes into the axis of the coil, then, as the current increases, the coil draws up the iron core and the battery plates, and increases the internal resistance, which diminishes the current.

Regulators which act on the useful resistance in the circuit—*i.e.*, in the case of electric lighting, the different arrangements made in electric lamps for producing steady currents between the carbon points, by keeping them the same distance apart, are very numerous, and I hope to treat of them in a future lecture.

Another kind of regulator controls the current by varying the external resistance of the circuit, so that when the current increases an additional resistance is thrown into the circuit, and when the current diminishes the external resistance is diminished. If a machine is working with the greatest efficiency, then the addition of external resistance will diminish that efficiency, so that a regulator which varies the external resistance diminishes the efficiency of the machine in order to maintain a steady current.

There are many ways of varying the external resistance of a circuit; for instance, a rheostat set in action by clockwork, which is started by an armature of an electro-magnet placed in the circuit. If, for instance, as the current is weakened, the armature of the electro-magnet falls and releases a wheel of a clockwork arrangement, which diminishes the resistance by unwinding the wire of the rheostat. The methods which have been employed have been gradually simplified, and it is found that the simplest means are at the same time the most efficient. For weak currents Edison's system, whereby a greater or less pressure on powdered carbon increases or diminishes its conductivity, has been employed. Edison also devised a regulator or shunt for the current, by the expanding of a platinum spiral wire placed in the lamp which short-circuited the current on reaching a certain definite temperature. Suppose, for instance, that an arrangement is made by which, when a current increases, part of it is sent through an electro-magnet, which draws up an arm so as to break the direct circuit, and send all the current through the electro-magnet, the resistance of the coil of the electro-magnet reduces the current, the arm falls, and again the current passes through the direct circuit.

Lane-Fox Regulator.

The regulator is an electro-magnet of very high resistance, which takes a branch of the current and acts on one end of a lever. The other end of the lever makes contact with one or other of two pins, which are connected with one or other of two coils forming electro-magnets, called respectively H and K, which govern either the throttle valve of the steam engine, or which may be made to introduce extra resistance by sliding contact over the wires of a rheostat. When the lever touches one of the pins, a current passes through the lever to the electro-magnet H, and turns the arm in one direction, and when it touches the other pin, the arm turns in the opposite direction, so that in one case the resistance of the circuit is increased and in the other it is diminished.

Siemens Regulator.

By means of the expansion of a fine strip of mild steel or fused iron stretched between two points, when the electric current passes through it, a vertical spindle, supporting a circular metallic disc, with platinum contacts on its upper surface, is lowered, so that the contacts of platinum, with certain points in a helical rheostat, are broken one by one, and at each break an additional portion of the rheostat is thrown into the circuit, and so the excess of current is checked. For the normal current the rheostat is out of circuit, but an excess of current heats the wire, lowers the platinum contacts, and brings more or less of the rheostat into the circuit. For small variations of current the change of current is nearly proportional to the change of temperature in the strip.

Methods of Measuring Electric Currents.

There are four principal methods of measuring powerful electric currents.

1. *The Galvanometer Method.*—With a tangent galvanometer of small resistance it is necessary to bring the deflections to about 45 deg. by a shunt of very small resistance, which sends only a very small part of the current through the galvanometer. Here there is a liability to error in the measurement of the resistance of the shunt. The objection to this method is that a small quantity is measured by the galvanometer, and the error of the observation is multiplied, it may be a thousandfold, or even very much more, in order to arrive at any idea at all of the total current flowing in the principal circuit. I can only compare the method to an attempt to estimate the flight of starlings, or of a covey of birds, by measuring or marking, as accurately as possible, the flight of one particular bird which has been separated from the rest, and which is assumed to travel at the same rate, no matter what obstructions or attractive influences may have come across its path. At the same time the difficulties of these measurements are so great that any method may be of great service, and this method has been employed by several observers with good results.

For strong currents, instead of a tangent galvanometer, Professor Trowbridge, of Harvard University, employs a galvanometer in which the coil carrying the current is capable of turning about a horizontal axis, passing through the centre of the needle. When the coil is vertical the instrument is a tangent galvanometer; but on turning the coil through any angle the part of the current which deflects the needle will be diminished. By this the current has very little effect in turning the needle when the coil is near the horizontal position.

2. *The Electrometer Method.*—The difference of potential between two points in a closed circuit may be measured directly, either by an electrometer like Thomson's quadrant electrometer, or by balancing the electromotive force between the two points, by a battery of the same electromotive force, in the circuits of which a galvanometer is placed, in which case the electromotive force is found by finding at what points the wires from the battery shall be attached, so that no current shall pass through the galvanometer. An instrument for the purpose I have described is Clark's potentiometer. This method has been employed by Dr. Hopkinson and by others to determine the current produced by a Siemens machine for the electric light. It has also been applied by Mr. Joubert and others to determine the current required to make the Jablochkoff candle burn at its best, and also for the estimation of the current given both by continuous current machines and also by alternate current machines for producing the electric arc.

3. *Method of using Thomson's Electrometer.*—If V be the potential of the needle, and V_1 V_2 the potential of the quadrants, and d the deviation of the needle, k being a constant, then

$$d = k(V_1 - V_2)\left(V - \frac{V_1 + V_2}{2}\right).$$

But, if the needle and one pair of quadrants be connected,

$$d = \frac{k}{2}(V_1 - V_2)^2, \text{ where } V = V_1,$$

so that the deviation is proportional to the square of the difference of potential, and is therefore independent of the direction of the current.

(TO BE CONTINUED.)

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The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

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West Indies.—The cable between Jamaica and Colon is interrupted.

Electric Light in Rome.—The Pincio has lately been lighted up by Messrs. Siemens and Halske.

Social Science Association.—The Social Science Congress will take place in Dublin from the 3rd to the 8th October.

Thunderstorm in London.—At two o'clock on Wednesday morning there was a severe thunderstorm in London. The flashes of lightning were very vivid, and heavy rain fell.

West India and Panama Telegraph Company.—The estimated traffic receipts of this company for the half month ended September 15 are £1,481, as compared with £514 in the corresponding period of 1880.

Electric Light at Stockholm.—The harbour and parts of the town of Stockholm are to be illuminated by the electric light. It is also under consideration to light the theatre and the King's Palace by the same means.

Electric Light in Norwich.—The Norwich Town Council have accepted the tender of Messrs. Crompton and Co., of London, for lighting several of the principal streets of the city by their arc lamps for twelve months.

The Telephone at Dunkirk.—A telephone line between the police station, fire station, and municipal buildings has been successfully erected under the supervision of M. Mauborgue, electrician, and M. Carpentier-Nivelle, the borough engineer.

SS. "Dacia" in the Shetlands.—The telegraph steamer "Dacia" has successfully lifted the second cable between the Orkney and Shetland Islands. As bad weather is coming on, however, the repairing is looked upon as likely to be a difficult matter.

Obituary Notice.—It is with regret that we have to record the death of Colonel Glover, who was well known in telegraphic circles. We shall hope in a future number to give some account of Colonel Glover's connection with telegraphic enterprise.

The Western and Brazilian Telegraph Company.—The traffic receipts of this Company for the week ending 16th September, 1881, were £1,829, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company.

Church Struck by Lightning near King's Lynn.—During a recent thunderstorm the church of St. Mary, of South Wootton, was struck by lightning. The tower and nave received a considerable amount of damage, the beams of the roof being charred.

Electric Light in Indian Cotton Mills.—It is stated that the Muir Cotton Mills at Cawnpore, started some years ago by some of the European residents, are in a flourishing state. The electric light is working well, and nearly doubles the out-turn of the mill.

Birkbeck Institution.—We notice that lectures, connected with electricity, magnetism, &c., will be delivered at this institution during the winter months on Friday evenings, by Mr. W. J. Wilson. The first lecture commences on Friday, the 7th of October.

The Telephone in South Australia.—We hear that a telephone line has been erected between the Exhibition in Adelaide and the Exchange; also that the Government, for the benefit of the public, intend to form a telephone exchange, to be worked under their own control.

French Naval Officers and the Exhibition.—We hear that all the officers of the French navy whose duties bring them into contact with electrical appliances will be sent to visit the International Exhibition. There is some idea, also, of permitting the telegraph clerks to visit the Exhibition.

Telegraph Extension in the Indian Gold Districts.—The *Madras Times* says that the construction of the Government land telegraph line from Ootacamund to Devala, to communicate with the heart of the gold mining district, is to be undertaken immediately, the authorities having given the requisite orders.

Prices.—The prices as quoted this week are, for gutta percha per lb.:—Genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber per lb.: Fine Para, 3s. 3d. to 3s. 4d.; negrohead, 1s. 11d.; central American, 1s. 5d. to 2s. 1½d.; Assam and Pegu, 8d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 4d. to 2s. 1½d.

Lightning Conductor Wanted.—The Guardians of Rotherham Union are inviting tenders for the erection of a lightning conductor at the workhouse. Tenders are to be sent to Mr. J. Barras, clerk to the Guardians, Rotherham, by the 30th September, and further information may be obtained from Mr. Turner, master of the workhouse, or of Mr. Barras.

Thunderstorm at Cannes.—The other day Cannes, in the South of France, was visited by a severe thunderstorm. The electric fluid struck the belfry of Holy Trinity Church, destroying the large stone cross and the massive arch containing the bell. The broken fragments of stone falling on the roof of the church have much injured it. A villa near was also struck and greatly injured.

University College, Nottingham.—Evening lectures on electricity and magnetism will be delivered by Professor Fleming at this college on Thursday evenings, commencing the 13th of October next. There will also be technical classes in electrical instrument making and telegraphy, on the scheme of the City and Guilds Institute, every Monday and Wednesday during the next session.

The Telephone and the Police.—In the new prison recently erected in the Moabit quarter of Berlin the telephone plays an important part. By this means the prison is placed in communication with the Courts of Justice, and when a prisoner is to be brought into court, the order is sent by telephone direct to the prison, thus saving the trouble incident to keeping prisoners waiting their turn at the courts themselves.

Electrical Cremation.—At a recent meeting of the Association Amicale des Anciens Elèves de L'Ecole Centrale, says our contemporary, *E'Electricien*, a member proposed cremation by electricity, to be effected as follows:—The body to be covered with platinum wires of suitable dimensions, and an electric current sent through the wires of sufficient duration to produce complete calcination. By this means no foreign matter would be introduced amongst the ashes.

Electrical Illuminations in Venice.—The illumination of various portions of Venice on the occasion of the Geographical Congress, combined with a visit from the King and Queen, have been very brilliant and beautiful. In these illuminations the electric light has played a conspicuous part, the façade of St. Mark's being lighted by reflected electrical light, so disposed as not to interfere with the general illumination, the effect of which is said to have been very beautiful.

Iron and Steel Institute.—The autumn meeting of this institute will be held in London on the 11th, 12th, and 13th

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of October. Although we do not see any papers connected with electrical science on the list of those to be read, matters electrical will not be altogether absent, as we notice that at 1:30 p.m. on Tuesday, the 11th October, a special train will convey members from Charing Cross to the telegraph construction works of Messrs. Siemens Brothers, at Charlton where luncheon will be provided by the firm.

Telegraph Stores Wanted.—The Directors of the Great Western Railway are inviting tenders for the supply of telegraph wire, instruments, and materials, india rubber goods, &c. Samples and patterns may be seen at the office of the Storekeeper, Paddington. Specifications and forms of tender may be obtained at the office of the storekeeper at the Swindon or Paddington Stations, and tenders must be addressed to Mr. Fred. G. Saunders, secretary, G.W.R., Paddington Station, sealed and marked "Tender for Stores," by the 3rd of October.

Electric Light in Clubs.—The British Electric Light Company have introduced their incandescent lamps into the smoking room of the Junior Carlton Club with success. The lamps are fed by Faure batteries, placed in the basement of the building. Fifteen lamps have replaced 25 gas burners, by which the room was ordinarily lighted; they have been grouped together beneath a reflector, so as to resemble the modified form of gas sun, which they have replaced. The work has been carried out by Mr. Radcliffe Ward, the company's engineer.

Tenders Required for Miscellaneous Stores.—Tenders are invited for the supply of the following stores during 1882:—Insulating thread, battery glasses, petroleum, glass fittings for Meidenger batteries, iron binding wire, copper wire, copper plates, copperas, porcelain cells, insulators, oiled and galvanised telegraph wire, zinc battery plates, &c. Conditions and details of quantities can be obtained on payment of one mark (1s.) from Dem Materialien Bureau der Kgl. Eisenbahndirektion, Elberfeld, Germany, where tenders will be received up to the 3rd of October.

Coating for Ships' Bottoms.—A correspondent sends us the following cutting from the Singapore *Straits Times*:—"It has been announced that Dr. Dennys, one of our police magistrates here, and secretary and curator of the library and museum, has patented a chemical invention for the coating of ships' bottoms and ironwork exposed to immersion in sea-water, which has been pronounced by experts here a great success, and likely to prove a fortune to the inventor." The composition alluded to owes its efficacy to a very slight galvanic action, which, however, does not attack the iron to which it is applied."

Direct Spanish Telegraph Company.—The report of the directors of this Company for the half year ending 30th June, 1881, to be presented at the general meeting to be held on Friday, 30th September, 1881, states that the accounts show a balance to the credit of profit and loss of £7,245. The result of the half year's working is satisfactory. The Company's cables and land-lines continue to work perfectly, the high electrical condition of the submarine cables showing no variation. The directors recommend that a dividend of 3s. per share on the Ordinary shares for the half year, free of income-tax, at the rate of 3 1-3rd per cent. per annum be declared.

Electric Light at the Royal Arsenal, Woolwich.—The Brush electric lights at the Royal Arsenal, which have for some time past been used in the Laboratory Department, and which were originally tried as an experiment, are to be continued for a further period. Experience has shown that as regards the purity of the atmosphere the electric light has proved itself superior to gas; but the workmen make several complaints against it, some of which are to be met by an alteration in the lanterns used. They say that the deep shadows which it throws upon parts of their work necessitate many expedients to get rid of them which are troublesome; they also state that it deceives them in the breadth of a line, and that the brightness affects their eyes so that they cannot see well when they get to their own homes and use ordinary lights, and that the blinking of the light affects the nerves of the eye.

Automatic Registering Stamp.—The registration of the number of letters or circulars which are sent out from an office or house of business is often required; hitherto no means other than that of actually counting has been devised for the purpose. Messrs. H. Ferguson and H. R. Kempe have recently invented and patented a simple apparatus for automatically effecting the registration either electrically or mechanically. When letters pass through an office they are impressed with stamps for obliterating, dating, and other purposes by means either of a hand or a lever stamp. Messrs. Ferguson and Kempe take advantage of this fact, and mount either the pad for inking the stamp, or the pad on which the letter is placed to receive the stamp, on spring supports, and provide electrical contacts, so arranged that when the pad receives the pressure of the stamp, a current of electricity is transmitted to an electrical counter, which is thereby moved one division.

International Electrical Exhibition.—To show the interest taken by the general public in this exhibition, we may quote from a daily contemporary's correspondent in Paris. He says:—"Three or four new pieces are announced for representation at various theatres this week, but the Electricity Exhibition runs every other attraction a very close race. It is perfectly marvellous to a commonplace observer to see a *queue* of three thousand persons waiting for their turns at the telephone to hear a few bars of music sung or played at the Opera, when they might hear the whole opera sitting at their ease and see the ballet as well. But such is the effect of novelty. It is for a similar reason that crowds gather round the Exposition of the Submarine Cable Company. They do not well understand what they see, but they know that, thanks to the cable, conversation can be kept up between the New World and the Old, and they gaze at the admirable apparatus and appliances in pardonable though childish amazement."

Electric Light at Kiel (Germany).—We recently described the illumination of some public gardens at Kiel by the electric light, on the occasion of the visit of the Duke of Edinburgh's squadron to that port. A correspondent of the *Daily News* contributes the following description of the disposition of the various lights throughout the town:—"The electric light has been brought to play here in several instances, and with prettier effect than I have seen for a long time—namely, the lamps are fastened indiscriminately on trees in a forest near the water, and without the usual shades, the carbons being open to wind and weather. The effect amongst green trees and bright rays shed on water is simply lovely. There is one long row of light and illuminated greenery from Kiel to Bellevue. The best illuminations in electric light are, curiously enough, supplied at his own cost by the unfortunate Herr Howaldt, whose ships 'Socrates' and 'Diogenes' still lie under arrest in a quiet and even now dark corner of this magnificent harbour."

A New Telegraph System for the United States.—From American advices just to hand it appears that the

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Baltimore and Ohio Railway is soon to establish its own telegraph system. Indeed that company expect to be ready for business within sixty days, or as soon as they can make the necessary arrangements. They have, it is said, already over 1,200 miles of wire in operation, and could establish a very respectable business as it is. These lines extend to Chicago, and were being extended through to St. Louis when they were interrupted by litigation at Vincennes. The company are now pushing on beyond there, and have material distributed along between twenty and thirty miles on the railroad beyond that point. They will run other lines to Chicago by way of Peoria as soon as they get the St. Louis connection effected. The most important business yet in establishing their lines is to reach New York City, and this is well in train. That done the company can open up whenever they please. Cleveland and Toledo will naturally be touched later, being too important business points to be left out. When the machinery is fully in operation the company will, it is said, push out in different directions and form a complete system.—*Railway Record.*

The Resistance of Liquids.—Measuring according to Kohlrausch's method the resistance and polarisation of a vessel of water slightly acidulated, containing platinum electrodes having a surface of 15 square centimetres, under the influence of E.M.F.'s varying between 0 and 2 Daniell cells, M. Emile Cohn concludes that the resistance is not altered by polarisation. He also experimented with a method of his own, by means of which he studied the effect produced at each electrode. He found that polarisation by hydrogen increases the resistance, whilst polarisation by oxygen diminishes it; this being due to the fact that in the case of polarisation by hydrogen a layer of pure water is formed at the electrode, which is of lower conductivity than the remainder of the liquid, whilst in the other case of polarisation by oxygen a layer of highly acidulated water, and, therefore, of superior conductivity, is formed. The effects, however, are not great. Thus, in a case where the liquid before polarisation had a resistance of 8·33 Siemens units, this resistance was decreased to 7·75 by polarisation by oxygen, and was raised to 8·73 by polarisation by hydrogen. M. Cohn is of opinion that in practice this difference may be neglected, and that the resistance of a liquid may be taken to be that determined before polarisation.

Carbons.—A Japanese physicist, Hanichi Muraoka, has ascertained the electrical attributes of certain classes of carbon to be as follows:—1. Siberian graphite, specific gravity 1·8, contains 98 per cent. of carbon, coefficient of expansion, ·0000038, temperatures 26,194,251, and 302 degrees, resistances in Siemens units ·0785, ·0693, ·0665, ·0646, specific resistance = 12·20; 2. Retort carbon, specific gravity 1·8, expansion coefficient ·0000015, temperatures 17·5 and 100 degrees, resistances in Siemens units ·246 and ·240, specific resistance = 52·23; 3. Carbon prepared for electric lighting purposes, temperatures 17 and 100 degrees, resistances in Siemens units ·360 and ·340, specific resistance = 48·44; 4. Other sorts of prepared carbon for electric lighting purposes, specific gravity 2·37, expansion coefficient, ·0000015, temperatures 26,165, 213 and 335 degrees, resistances in Siemens units, ·228, ·219. ·217, ·211, specific resistance = 42·90; 5. Prepared coke carbon for electric lighting purposes, made by Messrs. Heilman and Co., of Mülhausen, specific gravity 1·90, contains of carbon 98·1 per cent., expansion coefficient ·00000032, temperatures 28, 165, 240, and 338 degrees, resistances in Siemens units ·139, ·135, ·134, ·132, specific resistance = 39·10. 6. Faber's pencil leads, specific gravity 2·36, contains of carbon 52 per cent., expansion coefficient ·00000095, temperatures 120, 139, 159, 182, 210, 235, 261, and 287 degrees, resistances in Siemens units, 10·50, 10·38, 10·25, 10·14, 10·01, 9·891, 9·770, 9·649, specific resistance = 952. 7. Prepared carbon No. 57, made by Messrs. Kaiser and Schmidt, of Berlin, specific gravity 1·63, contains of carbon 98 per cent., expansion co-efficient ·00000205, temperatures 14·3 and 100 degrees, resistances in Siemens units ·652 and ·638, specific resistance = 36·86. 8. Other sorts of carbon made by Messrs. Kaiser and Schmidt, temperatures 11·7 and 100 degrees, resistance in Siemens units 1·224 and 1·186, specific resistance = 41·17. 9. Prepared carbon made by Gaudoin, specific gravity 1·55, contains of carbon 97·6 per cent., expansion co-efficient ·0000030, temperatures 31, 169, 229, and 322 degrees, resistances in Siemens units ·0836, ·0797, ·0784, ·0765. Muraoka also observed that between different kinds of these carbons thermo-electric currents arise. The electromotive forces are, though weak, distinctly evident.—*Zeit. für Angewandte Electricitätslehre*, Band. III., No. 18.

Magnetic Properties of Nickel and Cobalt.—M. A. Gaiffe has made some fresh experiments on the magnetic properties of nickel and cobalt. The specimens with which he experimented were obtained by means of the electro-chemical process described by himself and M. Adams before the Academy of Sciences in Paris on the 17th January, 1870, and the 15th July, 1878, the currents employed being of sufficient intensity to render these metals very hard. Having divided the specimens into bars of nearly equal dimensions, he left some bars of each metal in the hard state, others were annealed, others, again, were annealed and forged; all of them were magnetised at the same time and in the same way, and measured by means of a magnetometer. After being left for 36 and 72 hours they were again measured. He also found that some specimens of cobalt which acquired but feeble magnetic properties two years ago became strongly magnetic when experimented with recently without having been annealed or having lost any of their first hardness. M. Gaiffe concludes that it would seem, *à priori*, that the small coercitive force of these metals on being taken from the galvanoplastic baths is owing to the presence hydrogen in combination with them, and that on the disappearance of this, whether by the action of heat or by spontaneous disengagement, the nickel and cobalt resume their true coercitive force. The action of the hydrogen paralyses their magnetic power. The following is a *resumé* of the experiments showing the coercitive forces of the metals in different states, viz:—

1. Directly after magnetisation:—

	Deviations on the magnetometer.		
	Nickel.		Cobalt.
	deg. min.		deg. min.
Non-annealed bar	2 15	.....	5 30
Annealed bar	5 20	.....	11 0
Annealed and forged bar	7 0	.....	14 45
2. 36 hours after magnetisation:—			
Non-annealed bar	1 45	.....	5 0
Annealed bar	3 30	.....	9 30
Annealed and forged bar	6 0	.....	14 0
3. 72 hours after magnetisation:—			
Non-annealed bar	1 30	.....	4 45
Annealed bar	3 05	.....	9 0
Annealed and forged bar	5 30	.....	13 30
4. A bar annealed, magnetised, and again annealed	0 [illegible]	.....	1 15
5. A bar annealed, magnetised, and then forged	0 25	.....	6 0

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THE ELECTRICAL EXHIBITION AT PARIS.

Miscellaneous Exhibits.

Dynamo Machines.

We hope shortly to give illustrations of Pacinotti's original apparatus, when we think it will be conclusively shown that the claims of this able man have not been altogether recognised. Meanwhile, we may call attention to one or two machines which, for reasons that will be seen, provoke some special comment.

Hopkinson and Muirhead's Machine.—To the construction of this machine there has been brought both mathematical and scientific ability, and if past successes in the world of invention go for anything, Messrs. Hopkinson and Muirhead's machine should be a success. Still, as we have said above, we should like to know more of the theory upon which it has been constructed so as to compare it with other machines. The construction of the armature A (Fig. 1) is as follows:—Round the circumference of the pulley is coiled a band of sheet iron and of asbestos paper, so that the asbestos paper separates the successive layers of iron from each other.

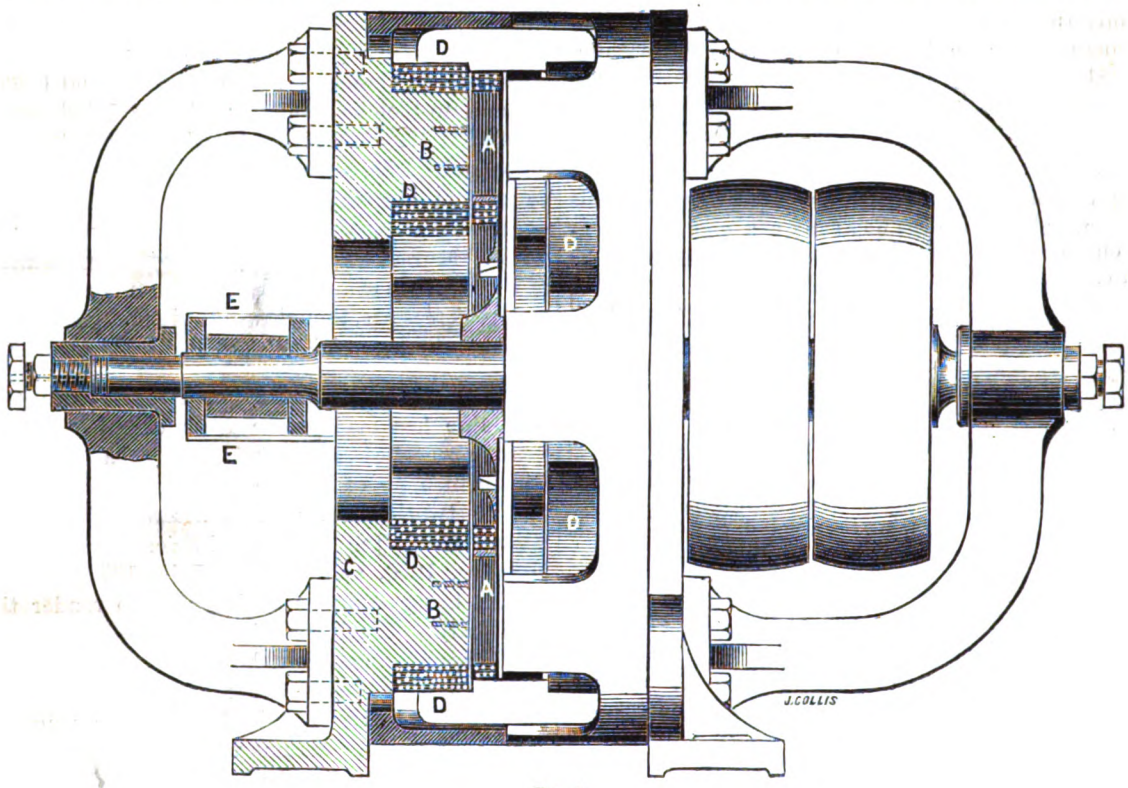

Fig. 1.

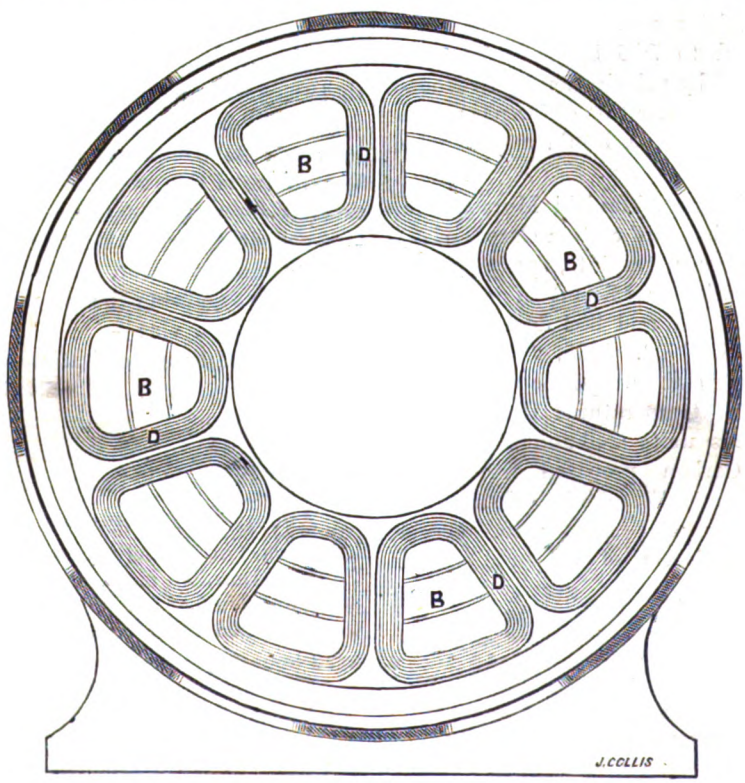

Fig. 2.

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When a sufficient thickness has been obtained radial holes are drilled, bolts inserted, and secured by cottars. If the bolts are put in and cottared hot the layers of iron and paper are more firmly nipped on to the pulley. The asbestos insulation may be superseded by painting the iron. Even superposing the layers is, however, said to give a better result than a solid ring. Having wound the iron bands, and bolted them firmly, radial slots are next cut on one or both sides of the ring to receive the coils of insulated wire. The illustrations show the armature as made for a continuous current machine, that is, with the slots on one side half-way between the slots on the other side of the armature. This is done in order that the current may be more approximately continuous; but when an alternating current is desired the slots in the opposite faces correspond. The field magnets are made in a similar manner to the armature, though not necessarily with precisely the same number of coils; it is cheaper to make their cores of solid wrought iron, and they may even be made of cast iron. It is advantageous to cut grooves in the face of the iron, and to fill up the grooves with insulated sheet iron, thus stopping the local currents in the cores which would otherwise occur. Both in the armature and in the magnets each coil is packed close against its neighbour. In Figure 1, B B are the cores of the electro-magnets, with a strongly cast iron backing, C C. The grooves of the cores, which are fitted with insulated sheet iron, are also shown. D D are the exciting coils, the connections of which are so arranged that the poles are alternately north and south, so that opposite to each north pole there is a south pole. E shows the commutator. Fig. 2 is a sectional view. To reduce sparks, and so increase the effectiveness of the machine, the collecting brushes are divided into parts, and that part which is latest in contact with any section of the commutator passes the current through a resistance, thus gradually checking the current as the contact is broken. The same effect may also be obtained by interposing equivalent resistances in the commutator itself.

Siemens' Alternate Current Machines.—The alternate current machine of Messrs. Siemens, as shown in the accompanying illustration (Fig. 3), is too well known to need

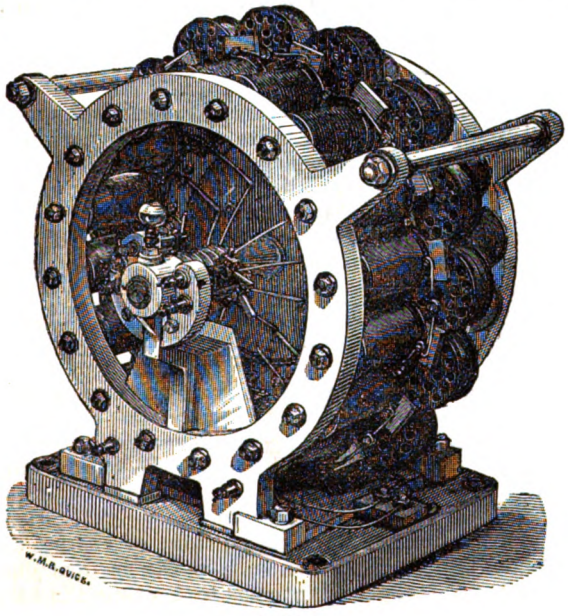

Fig. 3.

a long description, but it would be well to institute a comparison between the armature of this machine and that of Messrs. Hopkinson and Muirhead described above (Figs. 1 and 2). The armature in each case consists of a number of horseshoe-magnets arranged as in the figures. In the case of the Siemens machine the core of the magnet is as open as possible, whilst in the Hopkinson and Muirhead machine it is completely filled with iron. The armature of the latter is built up of iron rings, into which slots are cut and the wire wound in the slots. We are somewhat curious to learn what are the rival theories upon which these armatures are designed, as it seems to us one or the other must be wrong. There is another machine in the Exhibition, in the American section, with a similar armature, but in this case the core is a block of wood. The dissimilarity, and yet the similarity, is perplexing, and we hope this digression from our ordinary report may help to ellicit the views of electricians on the subject.

Electrical Water Guage.

Julius Sax, besides a number of electric bells, shows a water gauge and Fuller's Mirror Galvanometer. We shall presently describe this galvanometer, which is intended

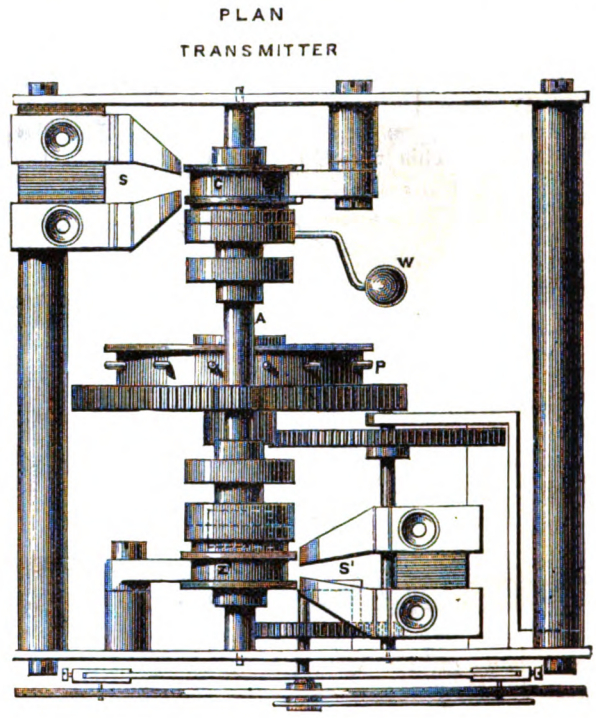

Fig. 4.

to improve the working of long submarine cables and to increase the rate of sending. Meanwhile, the mechanical and electrical water gauge consists of two parts—(1) the transmitter, fixed over or near the cistern; (2) the receiver, which may be fixed at any distance away from it. The wheel P of the transmitter (Fig. 4) carries a float, not shown in sketch, which float causes the wheel to turn in either direction. The

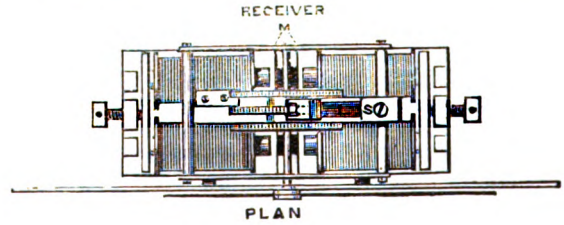

Fig. 5.

same wheel is geared into the pinion on spindle A, which pinion is calculated to turn round once at each inch of the rising or falling of the float. The same axle, A, carries two insulated weights, W, which are loose on the axle and can only travel in one direction by a small trigger arranged for this purpose. By the falling of the float the one weight, W, will be carried round, and so cause the contact C to pass over the springs S, sending a copper current through the lines to the receiver. By the rising of the float the second weight W would rise in the opposite direction, causing the contact Z to pass over the springs S^1, sending a zinc current in the line to the receiver. These two currents will cause the permanent magnet M of the receiving instrument, Fig. 5, to move either to the right

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or to the left, and so actuate the wheels carrying the hand. If the hand of the receiving instrument is adjusted and set to work with the hand of the mechanical dial, the former would always follow the latter, and so show the state of the water in cistern, reservoir, or river, at any distance away. The apparatus is also arranged to ring an alarm bell, both when the water has reached the highest or lowest points.

Relays.

Edison's relay consists of a glass tube, A (Fig. 6), with a bulb at the lower end, B, fixed in an ebonite disc, K, carried by three brass legs with levelling screws. On the disc are four binding screws to connect to line wires and to local battery, also two small spirit levels to show when the instrument is accurately levelled. In the bulb B is fixed the platinum wire F, ending at the insulating material G. On the other side of G is the platinum wire L turned up at the end to make the contact point M. A cross piece, H, on F carries the wire D. Normally, D does not make contact with M, and its normal position is maintained when the thin platinum wire C is cold. This wire C is the continuation of the line

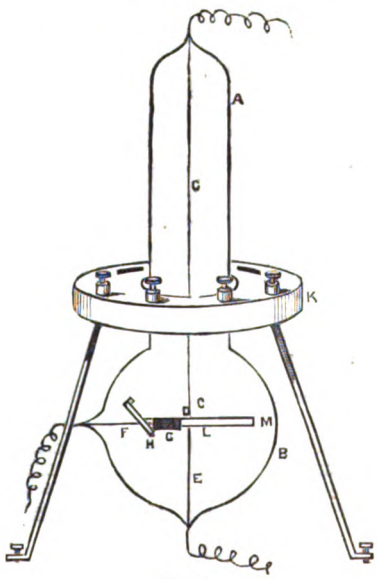

Fig. 6

wire, and as the current passes it is heated, and expands' making the contact for the local battery at M. It is stated that the relay works very satisfactorily and accurately in practice.

Telegraph Wire.

It is well known that the English wire-drawers in some branches of that industry are at a disadvantage with regard to some of their continental competitors when such questions as cost of carriage and facilities of transport are considered, but are not behind in quality. Messrs. R. Johnson and Nephew, of Manchester, show specimens of their productions. For example, a length of No. 00 B.W.G., weighing over 200lb., of best galvanised iron rod for cable armour, shows the great length that can be made in one piece without weld or joint. Another specimen is of No. 8 B.W.G. galvanised telegraph wire of low electrical resistance, to meet the requirements of the specifications of the Telegraph Department. For telephonic purposes, a special galvanised wire—No. 11—is prepared in pieces up to 140lb., which in practice have been found to work satisfactorily. Another specimen—No. 15—has a high breaking strain, and is prepared for erection in towns and cities, so that the factor of safety may be great and the chances of accident minimised. The Whitecross Wire and Iron Company, of Warrington, also show a number of specimens of wire, among which is a coil of conductivity wire for telegraphs, weighing 150lb, without weld or joint. This wire has ·171in. diameter, 1,075lb. breaking strain, a resistance of 12 ohms per mile, and a torsion of twenty twists in 6in. Another coil, weighing 150lb., of same diameter, has a breaking strain of 1,350lb., a resistance of 13 ohms, and thirty-six torsion twists in 6in. For cable purposes, a coil of wire is shown of special material, 0·73 diameter, having a breaking strain equal to 60 tons per square inch, bearing tests of winding round its own diameter and back again without breaking.

Magneto-Electric Brush.

This apparatus (Fig. 7) is shown by T. A. Rudge, of New Bond-street. The construction will easily be seen from the sectional drawing given herewith. A Siemens armature is made to revolve between the poles of a steel magnetised frame. The armature is put in motion by means of a train of wheels, to the axis of one of the wheels a brush or rubber of a metallic nature is attached. We cannot speak of the physiological action of the brush, or attempt to decide as to the efficacy of magnetic appliances in therapeutics. The

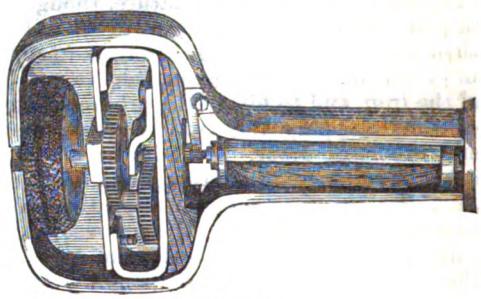

Fig. 7.

mechanical action, however, of this brush is that on being moved over the skin the armature revolves and a current of electricity is generated. It will be seen that this apparatus possesses the advantages of being portable, of not requiring a second person to turn a handle—in fact, is complete in itself. This brush is rather unfortunate, inasmuch as it was accidentally deranged, and it will hardly be found if sought for in any stand. We last saw it in the office of the British Commission.

ON THE HEAT GENERATED IN A MAGNET WHEN IT IS MAGNETISED AND DEMAGNETISED.

By Henry A. Rowland, Professor of Physics in the John Hopkins University, Baltimore, U.S.A.

When first as a student of physics I read that the mechanical energy of a cannon ball became transformed into heat when the ball struck the target, I remember wondering whether the heat was generated in the ball or in the target, and what would happen were the ball and target so hard that there should be no penetration of the ball into the target or any distortion of the ball. I remember that it required considerable thought for me to finally see that the heat was only generated in the softer body, and that when no distortion of shape took place no heat could be generated. But it was finally clear that the generation of heat took place in the ball or the target according as one or the other was the softer.

A raised weight represents stored energy, but if we let the weight fall the heat equivalent of the energy does not necessarily appear in the weight but may be generated entirely in other bodies and none in the weight. Just so a magnetised bar of iron represents a store of energy, and we often hear it stated that when such a bar is demagnetised the equivalent of the energy goes to heating the bar. So little has this subject been understood that some physicists have even gone so far as to investigate this generation of heat, thus supposing that they were investigating a subject whose laws were unknown.

My attention was first drawn to this subject by the description of an experiment made by Edison, and which was made when investigating, in a series of remarkable experiments, the losses of energy in a dynamo-electric machine. He there showed that a cylinder composed of sheets of iron separated by paper was scarcely heated perceptibly when revolving in a strong magnetic field, although the whole mass had its magnetism reversed twice every revolution. This proved

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distinctly that heat does not necessarily accompany magnetisation and demagnetisation, *but is almost solely the result of the electric currents induced in the revolving mass by the change of magnetisation*. And so, when the observers above referred to were experimenting on the heat produced by rapid magnetisation and demagnetisation, they were merely observing the heat produced by induced currents in the body of the magnet! The theory of the subject is perfectly simple. The raised weight or the magnetised bar both represent a store of potential energy, but when that energy takes the form of heat it does not necessarily appear in the weight or in the magnet, but may appear in some other body. The weight falls on a soft body and the heat is generated in it. The magnet may be incapable of having currents generated in it, and in that case the heat appears in a neighbouring conductor, and not in the magnet. Consider a piece of soft iron subjected to the magnetising force of an electric current in a helix around it. There is energy stored up in the magnetised iron. Stop the current, and what has become of the energy? Part has evidently appeared as the extra current, but part also goes to generating currents in the iron itself, and thus to heating it. Now place a copper tube around the iron and we shall observe that there is a new distribution of energy. The extra current is now weaker, and the iron is not heated so much; but the energy now appears as a current in the copper tube, and finally goes to heating it. Now divide up the iron in such a manner that no currents can be generated in it, and it is evident that less heat will be generated in it, nearly or quite the whole energy of magnetisation being expended in heating the copper tube, and in producing the extra current in the primary wire.

I do not mean to here affirm that no heat can be due to the demagnetisation alone, but that we have at present no experimental proof of such direct transformation. All the experiments hitherto made have merely given us the heating due to induced currents.

The importance of this principle in dynamo-electric machines is apparent, for although many have guarded against the generation of currents, yet I believe it is to Edison that we owe the experiment which first forcibly illustrated the fact that energy is *not necessarily* lost when a mass of iron is magnetised and demagnetised, but that any loss of energy can only arise from induced currents.

Paris, September, 16, 1881.

ON THE ECONOMY OF METAL IN CONDUCTORS OF ELECTRICITY.*

BY SIR W. THOMSON.

The most economical size of the copper conductor for the electric transmission of energy, whether for the electric light or for the performance of mechanical work, would be found by comparing the annual interest of the money value of the copper with the money value of the energy lost in it annually in the heat generated in it by the electric current. The money value of a stated amount of energy had not yet begun to appear in the City price lists. If £10 were taken as the par value of a horse-power night and day for a year, and allowing for the actual value being greater or less (it might be very much greater or very much less), according to circumstances, it was easy to estimate the right quantity of metal to be put into the conductor to convey a current of any stated strength, such as the ordinary strength of current for the powerful arc light, or the ten-fold strength current (of 240 webers†) which he (Sir William Thomson) had referred to in his address as practically suitable for delivering 21,000 horse-power of Niagara at 300 miles from the fall.

He remarked that (contrary to a very prevalent impression and belief) the gauge to be chosen for the conductor does not depend on the length of it through which the energy is to be transmitted. It depends solely on the strength of the current to be used, supposing the cost of the metal and of a unit of energy to be determined.

Let A be the sectional area of the conductor; s the specific resistance (according to bulk) of the metal; and c the strength of the current to be used. The energy converted into heat and so lost, per second per centimetre, is sc^2/A ergs.

Let p be the proportion of the whole time during which, in the course of a year, this current is kept flowing. There being 31½ million seconds in a year, the loss of energy per annum is

$$31{\cdot}5 \times 10^6 p\, s\, c^2 / \mathrm{A} \text{ ergs.} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The cost of this, if E be the cost of an erg, is

$$31{\cdot}5 \times 10^6 p\, s\, c^2 \mathrm{E} / \mathrm{A}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Let V be the money value of the metal per cubic centimetre. The cost of possessing it, per centimetre of length of the wire, at 5 per cent. per annum, is

$$\mathrm{V\,A} / 20. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Hence the whole annual cost, by interest on the value of the metal, and by loss of energy in it, is

$$\frac{1}{20}\mathrm{V\,A} + \frac{31{\cdot}5 \times 10^6 p\, s\, c^2\, \mathrm{E}}{\mathrm{A}}. \quad . \quad . \quad . \quad . \quad (4)$$

The amount of A to make this a minimum (which is also that which makes the two constituents of the loss equal) is as follows:

$$\mathrm{A} = \surd\left(31{\cdot}5 \,.\, 10^6 p\, s\, c^2 \mathrm{E} / \frac{\mathrm{V}}{20}\right) = c\surd(63 \,.\, 10^7 p\, s\, \mathrm{E} / \mathrm{V}). \quad (5)$$

Taking £70 per ton as the price of copper of high conductivity (known as "conductivity copper" in the metal market), we have £·00007 as the price of a gramme. Multiplying this by 8·9 (the specific gravity of copper), we find, as the price of a cubic centimetre,

$$\mathrm{V} = £{\cdot}00062, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

and the assumption of £10 as the par value of one horse-power day and night for 365 days, gives, as the price of an erg,

$$£10 / (31\tfrac{1}{2} \times 10^6 \times 74 \times 10^8) = \frac{1}{23 \times 10^{14}} \text{ of £1.} \quad . \quad (7)$$

Supposing the actual price to be at the rate of $e \times$ £10 for the horse-power year, we have

$$\mathrm{E} = \frac{e}{23 \times 10^{14}} \text{ of £1.} \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

Lastly, for the specific resistance of copper we have

$$s = 1640 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

Using (8) and (9) in (5) we find

$$\mathrm{A} = c\surd\frac{63 \times 10^7 \times 1640 \times p\, e}{23 \times 10^{15} \times {\cdot}00062} = c\surd\frac{p\, e}{1{\cdot}38}. \quad . \quad (10)$$

Suppose, for example, $p = {\cdot}5$ (that is, electric work through the conductor for twelve hours of every day of the year to be provided for), and $e = 1$. These suppositions correspond fairly well to ordinary electric transmission of energy in towns for light, according to present arrangements. We have

$$\mathrm{A} = c\surd\frac{1}{27{\cdot}6} = \frac{c}{5{\cdot}25} \doteqdot {\cdot}19\,.\,c.$$

That is to say, the sectional area of the wire in centimetres ought to be about a fifth of the strength of the current in webers.‡ Thus, for a powerful arc-light current of 2·1 webers, the sectional area of the leading wire should be ·4 of a square centimetre, and therefore its diameter (if it is a solid round wire) should be ·71 of a centimetre.

If we take $e = \frac{1}{27{\cdot}6}$, which corresponds to £1,900 a year as the cost of 5,250 horse-power (*see* Presidential Address, Section A), and if we take $p = 1$, that is, reckon for continued night and day electric work through the conductor, we have

$$\mathrm{A} = \frac{c}{\surd 381} \doteqdot \frac{c}{19{\cdot}5};$$

and if $c = 24$, $\mathrm{A} = 1{\cdot}24$, which makes the diameter 1·26 centimetres, or half an inch (as stated in the Presidential Address). But even at Niagara it is not probable that the cost of an erg can be as small as $\frac{1}{280}$ of what we have taken as the par value for England; and, probably, therefore, a larger diameter for the wire than ½in. will be better economy if so large a current as 24 webers is to be conducted by it.

NOTE.—Paris, Sept. 17, 1881. It seems that the designations used in this paper are not to be final. The volt is probably not to be altered, as the proposed change is objected to by the Paris International Congress on Electricity.—W. T.

* Abstract of a paper read at the British Association.

† It was called 240 webers on Wednesday in accordance with a usage never formally adopted by the British Association. The same current is now and henceforth to be called 24 webers. See second foot-note to this article.

‡ The weber of current is not to be ·1 C.-G.-S. any longer. It is henceforth and for ever to be 1 C.-G.-S., according to a resolution recommended at the present meeting of the British Association by its Committee on Electric Units. Practical men will be but too glad to forget the old volt of 10^8 and old weber of ·1 (never adopted by the British Association), and to adopt the British Association volt of 10^9, which, with the ohm of 10^9, makes the weber equal to the C.-G.-S. unit of current.

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FIFTY YEARS AGO.

The jubilee meeting of the British Association has furnished material for numberless essays upon the progress of science during the past fifty years, and electrical science especially has come in for a larger share of popular comment than, perhaps, was warranted by the President's address. The truth is, electricity and its foster-sister magnetism were only just beginning to walk when the British Association took them in hand, although they had lived in a state of aged childhood for many hundreds of years. The contemporaneous discoveries of Faraday gave the required impetus to a growth which had been remarkably slow; but the dozen years following 1831 saw the consummation of what appeared to be the goal of electrical science; and, until quite recent years, its history has been mainly associated with that of practical telegraphy. It has lately taken a fresh start, however, and, consequently, Sir John Lubbock's remarks upon this branch of his discourse were quite as much prophetic as historical. It is this which engages public attention at the present moment, what is going to be achieved having far greater attractions for the ordinary reader than what has become commonplace with familiarity. Yet the services rendered to mankind by electrical science in the past half century are not lightly forgotten, and will not easily be eclipsed by anything it is likely to accomplish in the next. The wonder is that it has achieved so much in so short a time; at all events nobody would have expected such great things of it immediately following the era which gave birth to the British Association. A brief glance at the records of its first meeting will make this point clear.

In the month of September, 1831, about 300 persons, "including many distinguished members of learned and scientific bodies in different parts of the kingdom," assembled together in the City of York. They had been invited by the Yorkshire Philosophical Society to what was described as a "meeting of the Friends of Science," with a view to the formation of an association designed to bring together the cream of all and sundry other scientific bodies. The British Association was to comprehend science as a whole, the specialists in every profession being welcomed to its meetings. It made a very good beginning, and evidently meant business from the very first. Sub-Committees were formed to arrange for its first formal gathering in the following year, and the subjects then to be brought forward were determined upon before the preliminary meeting broke up. It is interesting to note the recommendations of these sub-committees in respect to the subjects with which we are most concerned.

First, under the head of Magnetism it appeared to the committee "highly desirable that a series of observations upon the *Intensity of Terrestrial Magnetism in Various Parts of England* be made by some competent individual, similar to those which have recently been carried on in Scotland by Mr. Dunlop," and they suggest asking the Royal Society of Edinburgh for permission to make use of the standard Needle belonging to them, and constructed under the direction of Professor Hansteen, of Christiania. It also appeared desirable to this committee "that a certain number of observations should be made throughout Great Britain with the *Dipping Needle* in order to reduce the Horizontal to the true Magnetic Intensity."

The subject of Electro-Magnetism received even less attention, if we may judge from the solitary and curious recommendation of its committee, namely, that "an important subject for further prosecution" is "the examination of the *ElectroMagnetic Condition of Metalliferous Veins.*"

The two subjects, terrestrial magnetism and electro-magnetism, naturally follow each other; but it is significant that Electricity is relegated some distance further down the list, Optics, Acoustics, and Heat, all (in those days) unrelated subjects intervening. The committee, in the case of Electricity, do not commit themselves to anything specific, but merely suggest that "Professor Cumming be requested to prepare for the next meeting a Report on the state of our knowledge concerning Thermo-Electricity and the allied subjects in which recent discoveries have been made." This completes the programme so far as electrical science is concerned, and it cannot be said to be a very promising one.

At several meetings held in the course of the week papers were read, probably by way of tentatively illustrating the future conduct of these scientific *réunions*. It may be granted that the authors had not much time for preparation; but it is curious to note the paucity of material as well as the brevity of the account in each case, especially if we contrast them with the spontaneous and copious eloquence of every electrical tyro in these days. Mr. Abraham, in the magnetic section, if we may so call it, described "several useful applications of this science." One was "for preventing the prejudicial effects of needle pointing." Artisans engaged in this useful branch of industry—for needles had

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points in those days—are, or were, killed off prematurely by inhaling fragments of steel, and Mr. Abraham's device was to surround the object with powerful magnets. He regrets that "needle pointers" prefer high wages to long life, and that his good intentions were thrown away upon them. We trust Mr. Abraham lived long enough to get his reward from a wiser generation of hard steel grinders.

A more ambitious deliverance emanated from Mr. Scoresby, who gave "An exposition of some of the laws and phenomena of Magnetic Induction, and of the mutual influence of magnets on each other, with an account of a method of application of the magnetic influences for the determination of the thickness of solid substances not otherwise measurable." When we come to look into this mode of measuring substances we find that it consists in noting the deviation of a magnetic needle caused by a bar magnet placed on the opposite side of the object—a solid rock for example, "not otherwise measurable."

If we are not particularly struck with the practical character of this idea, we are interested in noticing the stage at which magnetic investigations had then arrived. It is worth remarking, too, that Mr. Scoresby is reported to have "described a bar magnet as a battery of magnetic particles, the arrangement of which being regular and consistent, transmits to the poles, like the galvanic pile, the general aggregate of their individual energies," and he defined in duced magnetism "as the development of the latent magnetism in iron or steel by the juxtaposition of any substance in a magnetic condition." Mr. Scoresby was evidently a bold shot.

On a subsequent evening Mr. Potter discussed the undecided question, "Whether or not electricity can pervade a perfect vacuum," a Torricellian vacuum being the nearest approach to that condition then attainable, and he inclines to the opinion that it can. Lastly, the account of Mr. Potter's paper is followed by something which fixes our attention instantly. It consists of only a few lines, and what they record does not appear to have attracted much notice among the members present, but they are well worth reprinting now. They read as follows:—"Dr. Warwick exhibited the method of making a powerful temporary magnet by coiling round a horse shoe of soft iron a quantity of copper wire, connecting the ends to the poles of a galvanic battery, as originally performed by Professor Moll, of Utrecht."

This extract fittingly closes the account of the initiatory meeting of the British Association so far as it interested itself with electrical matters. Probably nobody present at that meeting had the smallest inkling of what would come of this new "method of making a temporory magnet;" but looking at it from this distance of time we can see how close upon the threshold of great practical discoveries was the era we have been referring to. Viscount Milton, who presided, hoped that Government would by and by see fit to alter its attitude towards science, which in his opinion, much needed, as well as deserved, the assistance of national subsidies. Had he suspected the true value of even that one appliance illustrated by Dr. Warwick, he would have been little troubled by the want of Government patronage. And what was true fifty years ago is true now. Science, as science, is, or ought to be, pursued for its own sake; whatever of practical utilities spring out of it will make their own way without artificial aid from any quarter. We seem again to be at the beginning of a quite new departure in applied electrical science; we cannot predict what it may lead to, but we may be sure of this, that whatever in it is good and useful will in due time wax strong and prevail.

THE ELECTRICAL CONGRESS.

The Congress of Electricians held its first meeting on Thursday, the 15th inst., at three p.m., M. Cochery, Minister of Posts and Telegraphs, in the chair. Having welcomed the members of the Congress, M. Cochery proposed the election of six Vice-Presidents, viz., three foreign and three French, who were then elected as follows:—M. Jules Ferry and M. Carnot, Minister of Public Works, to represent France, one seat being left vacant, and Professor Helmhotz, Germany, Sir William Thomson, England, and Professor Govi, Italy, to represent the foreigners. The English delegates to the Congress who were present included the Commissioners appointed by the Government, the Earl of Crawford, Sir Charles Bright, Professor Hughes, and Colonel Webber, with Sir William Thomson, Dr. Warren de la Rue, Dr. Siemens, Mr. Graves, and Mr. Preece, Professors Adams, Clifton, Abel, Everett, and others. The work of the sections was begun on the following day. The officers of the various sections were appointed as follows:—First Section: President, M. Dumas, Secretary of the Academy of Sciences; Vice-Presidents: Professor Kirchoff, of Berlin; Dr. Warren de la Rue, of London; Secretaries: M. Gérar, Telegraph Department, of Belgium, and Professor Mascart, of France. Second Section: M. Cochery, President; Secretaries: Signor Don Ordima Y. Munoz, Director of Telegraphs in Spain, and M. Rother, Director of Swiss Telegraphs. Third Section: Mr. Spottiswoode, President of the Royal Society of London, President; M. Becquerel, Member of the French Institute, and M. Belpaire, of Brussels, Vice-Presidents; M. Egoroff, of Russia, and Colonel Sebert, of the French Marine Artillery, Secretaries.

The general meeting was to have been held on the 20th instant, but was postponed until the 21st on account of the death of General Garfield. At the meeting the report of the First Section on Electrical Units was received, and the following resolutions adopted:—1. The following fundamental units will be adopted for electrical measurements—the centimètre, the gramme-masse, and the second. 2. The practical units, ohm and the volt, will retain their present definitions, raised to the ninth power for the ohm and to the eighth power for the volt. 3. The unit of resistance, the ohm, will be represented by a column of mercury of a square millimètre section at the temperature zero centigrade. 4. An international commission will be appointed to determine by new experiments for actual practice the length of the column of mercury of a square millimètre section at zero temperature centigrade which will represent the value of the ohm. 5. The current produced by a volt in an ohm will be called an ampère. 6. The name coulomb will be given to the quantity of electricity which is defined by the condition that an ampère gives a coulomb per second. 7. The name farad will be given to the capacity defined by the condition that a coulomb in a farad gives a volt. We shall hope to give further details of the meetings of the Congress in another issue.

A MODIFICATION OF THE ELECTRIC LAMP.

As soon as he had discovered the electric arc Davy placed it in a vacuum, and observed that its length augmented, and that the carbons were no longer consumed. Owing to the difficulty of such an experiment, it has rarely been repeated; but M. Jamin, the inventor of the Jamin candle, has recently performed it with results which promise to influence the future of arc lamps. The Jamin candle is well adapted for the purpose, being small and free from regulating mechanism. It consists, as will be remembered, of two vertical rods of carbon placed parallel downwards, and the arc is established across the lower points and deflected outwards by electro-dynamic circuit on itself.

Instead of a vacuum M. Jamin prefers to fill the exhausted vessel with a gas having no action on the carbons. Such a gas is nitrogen, acetylene, carbonic oxide, marsh gas, and probably sulphuret of carbon. Most other gases are decom-

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posed. Thus vapour of water gives carbonic oxide and acetylene, carbonic acid doubles its volume and changes into carbonic oxide. The carburetted hydrogens, and particularly petroleum vapour, are decarbonised, and give birth to filaments of coke, which connect the points of the carbons, and turn an arc lamp into an incandescent one.

When air is filled into the sealed vessel containing the Jamin arc, coloured vapours are first seen formed by combination of the oxygen and nitrogen under the influence of the arc. But this compound is soon destroyed, and the hyponitric acid is decomposed to furnish oxygen to the carbon. Finally there remains only nitrogen and carbonic oxide in the vessel.

During this time the arc experiences corresponding modifications. While the vapours are present it varies in colour and intensity. But in proportion as the gas is decolourised, the flame is fixed and changed in tint. At length, when all the chemical transformations are accomplished, it is reduced to a very distinct, full light, of a greenish blue colour. But the most important point is that it takes a complete fixity, which gives it an invariable splendour between the carbon points. This fact will tend to free electric arc lights from the flickering due to inequalities in the carbons.

The spectrum is furrowed by an incredible number of very fine and almost regular rays, which constitute its very close tissue. Beyond that it offers in divers parts a very unequal brightness. We see in it four great maxima which arise suddenly from the least refrangible side by a very brilliant line, which repeats itself afterwards at equal distances in growing feebler. These maxima are in the yellow-green, green, blue, and violet. They alone remain visible when the light decreases. We recognise then the spectrum of the blue flame of alcohol or of gas, that of carburetted gas traversed by the spark of a Rhumkorff coil, and at last that of the recent comet, as M. Thollon has found. It is the electric spectrum of the vapour of carbon rendered incandescent without burning.

In the open air a different state of things goes on; the carbon burns, the arc is red, and in the spectroscope we can see the spectrum just described alternate with another, which is due to combustion, and is quite different. The latter presents a splendid assemblage of rays, due to the combustion of metals contained in the carbons. It is evident that in an inert gas we have a purely electric phenomenon, that the arc is a current which we can direct and maintain invariably at the points by electro-magnetic action. For this reason the light takes a remarkable fixity.

In free air, on the contrary, the phenomenon is complex. There is still the current which we can fix, but there is also the combustion of the carbons with which we can do nothing, and which varies ever and anon with the irregular wasting of the carbons.

In confined air, again, we have, first, the spectrum of combustion, and as soon as the chemical transformations commence the electric spectrum appears. We do not see both at the same time, for they succeed and replace each other. Little by little the duration of the first spectrum diminishes, and, finally, the electric spectrum alone remains. This happens when all the oxygen has combined with the carbon to form carbonic oxide. It is remarkable that in the two cases the arc is characterised by spectra so dissimilar, and that the oscillations of the light are only an indication of the passage of one spectrum into the other.

A point of practical interest is that the carbons, in ceasing to burn, stop wasting to a like degree. When the Jamin candle is operated in the air with a medium current, the waste of carbon is about 0·16 metre per hour, and as there are five candles of 0·32 metre per lamp, it lasts ten hours, or, say, a night. In the closed apparatus, in proportion as the gas is transformed, the usage decreases rapidly and reduces itself to 0·002 metre per hour. Each candle lasts 160 hours, each lamp 800 hours, or eighty nights of ten hours. The electric lamp becomes almost perpetual under such conditions as these—the carbons can be replaced when the lamp is cleaned, their quality is of minor importance, the lamp requires no daily care, and the light acquires a fixity just now unknown. The Jamin arc is at once established as soon as the current is put on.

In practice it will be necessary to reduce as much as possible the dimensions of the globe of glass which will contain the burner, and to prevent the external air from entering it. In other words it requires to be hermetically sealed.

CANTOR LECTURES.*

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

BY PROFESSOR W. GRYLLS ADAMS, F.R.S.

LECTURE II.—DELIVERED MONDAY, MARCH 14, 1881.

(CONTINUED FROM PAGE 287.)

By means of two electromoters so arranged, the current and the energy expended between any two points of a circuit may be at once determined. First consider the case of a continuous current. Let one electromoter have its poles attached to two points A and B of the circuit where the potentials are V_1 and V_2, having a resistance r_1 between them and a current C, then

$$Cr_1 = V_1 - V_2.$$

Now take two other points, C and D, in the same circuit, which have a difference of potential $V_3 - V_4$, and which have an electromotive force, E, as well as a resistance r_2 between them, then

$$E + Cr_2 = V_3 - V_4.$$

Then the energy expended between these two points is

$$C(E + Cr_2) = \frac{(V_1 - V_2)(V_3 - V_4)}{r_1},$$

so that the deflection of the two electrometers will at once give the

$$\text{Energy expended} = \frac{2}{r_1}\sqrt{\frac{d_1 d_2}{k_1 k_2}}.$$

One electrometer gives the current, and the two together give the work expended.

If, instead of a continuous current, we have alternate currents succeeding one another at intervals which are very short compared with the time of oscillation of the needle, then the needle will remain steadily deflected at a deviation proportional to the mean value of the square of the difference of potential—

$$d = \frac{k}{2}(V_1 - V_2)^2.$$

In this case the differences of potential must be measured absolutely at the same instant. This may be done by placing two contact breakers on the revolving axis of the dynamo machine, so arranged that by both of them contact is made and broken at the same instant some 20,000 times in a second, then the two electrometers will give the desired results. In place of the electrometer which is employed to give the strength of current a galvanometer may be employed, as in Clark's potentiometer, in which case it is only necessary to have one contact breaker, and so the arrangements are more easily made.

The law of variation of the current in alternate current machines may be obtained by the law of variation of the resistance for different periods of contact, *i.e.*, for different phases of rotation of the contact breaker. Thus the different phases of the current may be studied by dividing the period into a certain number of equal parts, and, by means of the contact breaker, making contact only at the same phase of the period of revolution.

The intensity of the light at the different phases of the period may also be studied and measured by means of revolving discs with holes in them, arranged so as to let light through only at the proper instant. The result of experiments is that the law of increase of current in alternate current machines is the law of simple harmonic motion, but the maximum effect does not occur at the normal position, but is displaced in the direction of the motion. Experiments, of which a full account has been given in *La Lumière Electrique*, have shown that even with coils alone there is a retardation of the inductive action arising from the induction of a current on itself. The retardation is about $\frac{1}{8}$th of the whole period, even with a bobbin without a soft iron core, and this displacement is independent of the velocity, and rigorously the same for 400, 700, or 1,000 turns in a minute. In the case of magneto-electric

* Reprinted from the *Journal* of the Society of Arts for August, 1881.

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machines, there is a retardation which is usually attributed to the retardation of magnetisation of the magnet, but that does not apply to the case of coils, in which case the retardation depends on the self-induction of the current. By the above method, the fall of potential between the carbons in the arc may be measured at different phases of the period of revolution. Thus it is found that at the instant when the circuit is made there is no difference of potential, but in an indefinitely short time the electromotive force rises to 40 or 45 volts, and remains at that value almost without change until the current again becomes very feeble, and then the electromotive force suddenly falls. The difference of potential in the arc seems to be constant within very wide limits for the values of the current. The conclusions arrived at by M. Joubert are that the resistance of the arc is very small; that it varies with temperature and diminishes as the temperature increases. The difference of potential between the two carbons is due to an electromotive force, which is independent of the current, and which is estimated by him at 30 volts. Particles pass between the carbons just as between the electrodes in a voltameter. There seems to be an action like polarisation, and the work done depends only upon, and is proportional to, the quantity of electricity which passes.

Another method of measuring the currents which is applicable to both continuous currents, and to obtain the average values of alternate currents, depends on the development of heat in an electric circuit. It was shown by Joule, and follows from the law of transformation of energy, that the heat developed by a current C in a resistance r in time t is $C^2 r t$, hence the current C may be measured by the quantity of heat received in a given time by water, in which a resistance r is immersed. This method has been employed by Dr. Siemens, and was one of the methods employed by Dr. Hopkinson in measuring electric light currents.

In his experiments, Joule inserted a wire of known resistance in a given quantity of water placed in a calorimeter, and measured the change of temperature of the water, and also measured the current, and found that $H = C^2 r t$ where H is the quantity of heat produced by the current.

The Electro-Dynamometer Method.—There is still another meteod of measuring currents, which Maxwell says, "is probably the best fitted for absolute measurements."

In Weber's electro-dynamometer, one coil is suspended within another, by means of two fine wires, through which the current is led to the suspended coil. This arrangement is not suitable for powerful currents, because shunts become necessary, and because the suspended wires become heated.

An electro-dynamometer on the same principle has been devised by Dr. C. W. Siemens, who has kindly lent me one of his instruments for these lectures.*

Attached to a binding screw (3) is one end of a fixed coil or bobbin, across which a single turn of copper wire with its ends dipping into two mercury cups, is freely suspended in a vertical plane, so as to turn about a vertical axis. One of the mercury cups is electrically connected with the binding screw (1), and the other with one end of the fixed coil, so that between 1 and 3 the same current passes through the fixed coil and suspended wire. When the current passes, the suspended wire tends to turn about a vertical axis, but its motion is counteracted by a torsion spring, to one end of which the wire is attached, the other end being fixed to a socket carrying an index, which must be moved over a graduated circle, so as to bring the suspended wire back to its initial position. The action between the currents in the coils, and therefore the torsion which measures it, is proportional to the square of the current. By increasing the number of turns in the fixed coil, and having only one turn in the suspended wire, the action of the earth's magnetism on the current in the suspended wire may be neglected in comparison with the action of the fixed coil upon it, so that the position of the plane of the magnetic meridian at the place of observation may be disregarded in using this instrument. There are usually two fixed coils or bobbins, one coil, attached to binding screw (3), being of a small number of turns of thick wire for continuous currents; and the other, attached to binding screw (2), being much longer and finer, for use with machines giving alternate currents or currents of high tension.

An electro-dynamometer has also been devised by Professor Trowbridge, of Harvard University, in which there are two large fixed coils made from copper bands, between which is suspended from a torsion head a small coil with mercury connections, so that all the current passes through each coil. This instrument has been improved by Mr. W. N. Hill, who limits the swing of the central coil, and measures the current by bringing the coil back to its zero position by balancing the force of repulsion of the coils by weights placed in two scale pans, one on each side of the instrument, so as to balance the action of the current by torsion of the suspending wire. If C be the current, $w\ l$ the twisting moment of the weight w, G, and g the constants for the two coils, and k the constant of the instrument,

$$\text{then } C^2 = \frac{l\ w}{k\ G\ g}$$

G and g are found by measurement, and k is found by comparison with another instrument. Through the kindness of Messrs. Elliott Brothers, I have the opportunity of bringing before you an electro-dynamometer of this form with the latest improvements.* This form of dynamometer is especially applicable for large currents, since the weights required to bring the deflection to zero increase as the square of the current, and so greater accuracy may be attained.

(TO BE CONTINUED.)

* An illustration of this instrument will be found in *The Electrician* Vol. vii., No. 16, p. 246.

ON THE APPLICATION OF ELECTRICITY TO THE LOCALISATION OF A BULLET IN A WOUND.†

BY W. H. PREECE, F.R.S

Any application of electricity that can aid the practice of surgery, and lead to the total suppression of pain, must fulfil one of the highest functions of the art of applying the great forces of nature to the wants of man.

I purpose to show how an electric current can be made an invisible and immaterial probe, localising the position of a bullet, without touching the human body, or inflicting the slightest sensation of pain.

Electricity has already been used for probing purposes, but only to detect, by the ringing of a bell, the fact that a metallic mass has been touched by the point of the instrument. The operation was performed with all its pain to the wounded sufferers, and electricity was employed only as an agent more sensitive than the touch.

The conception of using electricity alone as the tool itself for this purpose occurred to Professor Graham Bell in Washington. He telegraphed to me on the subject to consult with Professor Hughes as to the use of his induction balance for the purpose. Professor Hughes threw his whole heart into the matter. Full directions were sent out to Professor Bell, who was independently experimenting on the subject with Dr. Tainter. Experiments were made by him upon President Garfield, and there is every reason to believe that the position of the bullet has been unmistakably localised.‡

Although Hughes's induction balance is well known a brief *resumé* of its principle will aid my purpose. Whenever a current of electricity flows through a wire it converts the neighbourhood of that wire into a magnetic field. A magnetic field is a term applied to any space subject to the influence of magnetism, and it is characterised by being permeated with lines of magnetic force which have somewhat the same reference to magnetism that rays of light have to light itself. Whenever a conductor moves through these lines of force, or whenever these lines of force are projected through a conductor, a current of electricity is generated in the conductor. Now, if we take our wire, and form in it a coil, A, and pass a current of electricity through this coil, its neighbourhood becomes a field, and if we place in this field another coil, a, a current of electricity will be induced in that coil for every current that passes through A in virtue of the lines of force which are projected through it. The strength and direction of this induced current will depend upon the strength and direction of the primary or inducing current in A, and upon the intensity of the magnetic field and the direction of the lines of magnetic force passing through it. Anything that disturbs this field will vary the current in a.

Now Z is a battery of 4 or 5 galvanic cells, and M is a make and break which rapidly and rhythmically interrupts the flow of the current through A. B is another coil precisely similar to the first, through which the same currents flow, and β are two coils of wire precisely similar to each other, but so connected that the currents induced in the one are in the reverse direction to those induced in the other. T is a telephone which, when applied to the ear, indicates with great sensitiveness any currents, however delicate they may be, flowing. If the system be connected up as shown in the diagram and the interrupter be set going there will be silence in the telephone, because the currents that are induced in the one coil are neutralised by

* A detailed description, with illustrations, of this instrument will be found in *The Electrician*, Vol. vi., No. 20, p. 246, and No. 22, pp. 281 and 282.

† A paper read before the British Association, York meeting.

‡ See *The Electrician*, Vol. vii., No. 15, p. 237.

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those induced in the other. If, however, a piece of metal, such as a shilling or a bullet, be placed anywhere in the field of A, other currents are induced in the piece of metal, the lines of force are disturbed, equilibrium is destroyed, and sounds are heard in the telephone. These sounds can be again destroyed by inserting in the same position of the field of B, another similar piece of metal, or varying the distance between the primary and secondary coils B and *b*, or by varying the field of B. Hence a graduated scale can be used to obtain measurements of the amount of disturbance. The instrument is so sensitive that it can trace the smallest impurity in a sovereign, and Professor C. Roberts showed us at the *soiree* last night how it has been utilised in the Mint for the detection of bad coinage.

In order to apply this apparatus to the localisation of a bullet in a wound, Professor Hughes recommended that the pair of coils $\frac{A}{a}$ should be made made movable and portable, so that they might be moved over the body of the wounded man. He anticipated that if the coils were brought within three inches of the bullet its presence would be detected. The bullet could readily be brought in a line of the axis of the coils by observing the position of maximum sound. It remains when that is done to ascertain its depth. This can be effected by moving a similar bullet in the field of B, and along its axis until neutrality is obtained, then the depth of the trial bullet will be that of the buried one. Or if the size of the bullet is not known, a scale of zinc could be used to obtain neutrality which would give the depth by calculation. The apparatus admits of much variation in form, and I have no doubt that Professor Hughes will shortly devise a practical form which can be placed in the hands of any surgeon.

Professor Bell and Mr. S. Tainter have worked assiduously at the matter, and have modified the instrument, and considerably increased its sensitiveness. They have extended its range to five inches. Professor Bell's report to the surgeons in attendance on Professor Garfield is interesting :—

"I beg to submit for your information a brief statement of the results obtained here with the new form of induction balance in the experiments made this morning for the purpose of locating the bullet in the person of the President. The instrument was tested for sensitiveness several times during the course of the experiments, and it was found to respond well to the presentation of a flattened bullet at a distance of about four inches from the coils. When the exploring coils were passed over that part of the abdomen where a sonorous spot was observed in the experiment made on July 26, a feeble tone was perceived, but the effect was audible a considerable distance around this spot. The sounds were too feeble to be entirely satisfactory, as I had reason to expect, from the extreme sensitiveness of the instrument, a much more marked effect. In order to ascertain whether similar sounds might not be obtained in other localities, I explored the whole right side and back below the point of entrance of the bullet, but no part gave indications of the presence of metal except an area of about two inches in diameter, containing within it the spot previously found to be sonorous. The experiments were repeated by Mr. Tainter, who obtained exactly corresponding results. We are therefore justified in concluding that the ball is located within the above-named area. In our preliminary experiments we found that a bullet like the one in question, which in its normal shape produced no audible effect beyond a distance 2½in., while the same bullet flattened and presented with its face parallel to the plane of the coils gave indications up to a distance of nearly 5in. The same flattened bullet held with its face perpendicular to the plane of the coils produced no sound beyond a distance of one inch. These facts show that in ignorance of the actual shape and mode of presentation of the bullet to the exploring instrument the depth at which the bullet lies beneath the surface cannot be determined from our experiments."

This shows that much remains to be done to render the instrument practical and useful, but nevertheless we have clear evidence of a new application of electricity which will be beneficial and valuable.

Electricity and Electric Conductivity of Carbon.—Beetz, in the *Ann. Phys. Chem.*, states that the modulus of electricity of the coke used for the electric light is deduced from the note emitted when a piece is thrown into acoustical vibration. Experiments on the electric conductivity show an irregular decrease in the resistance with the rise of temperature at first, and afterwards an increase. The author explains this irregularity by attributing to the coke a structure similar to that of certain metallic oxides (*e.g.*, pyrolusite). —*Journal of Chemical Society*, September number.

ON THE ELECTRIC CONDUCTIVITY AND DICHROIC ABSORPTION OF TOURMALINE CRYSTALS.*

BY PROFESSOR SILVANUS P. THOMPSON, B.A., D.SC.

1. According to Clerk Maxwell's electro-magnetic theory of light, all good conductors of electricity should be opaque to light. This corollary of that famous theory cannot be said to have been confirmed as yet in its entirety. Professor Maxwell himself mentions that gold appears, from Mr. Hockin's experiments, to be more transparent than theory would indicate. He also refers to the exception furnished by the case of electrolytes such as dilute sulphuric acid, which, though possessing good electrolytic conducting power, is transparent. The explanation he offered has also not yet been decisively tested. The present writer has partially examined two other cases coming under the above corollary of the theory, these cases being:—

(1.) The change in colour of certain absorbing media when their temperature is raised.

(2.) The unequal opacity to light in different directions possessed by tourmaline and other dichroic crystalline media.

In the first of these two cases the author has inquired whether the colour change on heating observed in many bodies, glass, porcelain, metallic oxides and sulphides, minerals, and notably in realgar and in cuprous mercuric iodide, can be explained by any increase of electric conductivity at the temperature at which the change in colour occurs. The result of an investigation into the relation between temperature and electric conductivity of the last named substance—cuprous mercuric iodide—is communicated to Section B of the present meeting of the Association.

The unequal opacity to light in different directions which gives rise to phenomena of dichroism in tourmaline and other crystals has also been investigated by the author. He has re-written the general equations of the electro-magnetic theory of light as given by Maxwell for the case of a medium in which the magnetic and electric inductive capacities and the volume-coefficient of electric conductivity have different values along three rectangular axes; and he has further considered the particular case of a plane wave propagated normally in such a medium along one of the three axes, and has deduced the result, that since the tourmaline (which is a uniaxial crystal) conducts electricity across the axis more readily than along it, it will be more opaque to rays of light travelling along the axial direction than to those travelling in a direction at right angles to the axis. This conclusion is in agreement with the optical deportment of all coloured tourmalines, and, indeed, of all coloured negative uniaxial crystals. He has also argued that in the case of the rays traversing the crystal at right angles to the axis the component of the vibrations resolved in the direction of best conductivity will be more completely absorbed than the component resolved at right angles to that direction. This also agrees with the known property of tourmaline in absorbing rays polarised in a plane parallel to the principal axis of the crystal. These results were communicated to the Physical Society in June, and have been published in the *Philosophical Magazine* for August, 1881, p. 112.

Theory also indicates that uniaxial crystals in which the electric conductivity is greater along the axis than across it should be more opaque across the axis than along it, equal thickness of the crystal being considered. Now, this is the case in several coloured uniaxial crystals, for example, *smoky quartz* and *Lommellite* (magnesic platino-cyanide). The writer has had no opportunity of examining the electric conductivity of these substances, but he has little doubt that they will be found to conduct better along the axis than across it. Both are negative crystals, and it is generally conceded that in negative crystals the *thermal* conductivity is higher along than across the axis; in which case the electric conductivity should also be higher along the axis.

If a slice of crystal bounded by two principal planes of section be taken, and a ray of light be incident upon it normally, the vibrations will be resolved into two parts respectively parallel and at right angles to the axis, which will not only be propagated at different rates, but which will be absorbed at different rates in their passage through the medium. The ray whose vibrations are executed in a direction perpendicular to the axis is usually called the *ordinary* ray, and that whose vibrations are executed in a direction parallel to the axis is called the *extraordinary* ray. If μ_1, C_1, V_1, respectively represent the co-efficient of magnetic induction, the volume co-efficient of conductivity, and the velocity of propagation of a displacement in a direction parallel to the axis, and μ_2, C_2, V_2 the same quantities in a direction perpendicular to the axis, then by Maxwell's theory the intensities of

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*A Paper read at the British Association—Section A.

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the transmitted portions of the two rays will have the following ratio :—

$$\frac{I_\epsilon}{I_0} = \frac{\epsilon^{-\mu_1 C_1 V_1}}{\epsilon^{-\mu_2 C_2 V_2}}.$$

Now in tourmaline, $C_2 > C_1$, and the like is probably the case in all negative crystals. While in positive crystals $C_1 < C_2$. It will, therefore, follow that of crystals possessing electric conductivity positive crystals should absorb the extraordinary more than the ordinary ray, and negative crystals should absorb the ordinary more than the extraordinary ray, as was, indeed, first pointed out by Babinet to be the case.

Another consequence of the equation given above is that if rays of light of different frequency are propagated at different rates, in other words, if there is chromatic dispersion in the medium, then the co-efficients of absorption will differ in different directions for light of different colours. In the case of tourmaline, C_1 is less than C_2; and where C_1 is small any difference in the values of V_1 for different kinds of rays will have relatively greater importance. It should, therefore, be expected that as red rays are less retarded than violet rays in passing through dispersive media there should be relatively less absorption of red rays than of violet in the more absorbed of the two rays. There will, therefore, be a difference of *tint* in the body of rays transmitted in the two chief directions through the crystal, a phenomenon perfectly well known to mineralogists under the name of *dichroism*.

The electric and optical behaviour of these crystals may be imitated by models. A cube built up of allimate horizontal layers of wire-gauze and glass, for example, imitates the tourmaline.

Amongst other deductions for theory are the following :—

Crystals in which the electric conductivity has differeut values in three rectangular directions will be *tri-chroic*.

All coloured crystals will be either *di* or *tri-chroic*, except those of the first or cubical system.

The author exhibited crystals of tourmaline and herapathite, and also of magnesic platino-cyanide, which differs from the former crystals in having *minimum* opacity along the crystallographic axis.

ON A NEW SCREW GAUGE FOR ELECTRICAL APPARATUS.*

BY W. H. PREECE, F.R.S.

It is very desirable to establish a gauge for the manufacture of the various small screws used in the construction of telegraphic and electrical apparatus. Sir J. Whitworth in England and the Franklin Institute in America have done this for the bolts and screws used in millwork and engineering generally, but no one has extended either system to the finer work used in the numerous practical applications of electricity that are now becoming so important. Gauges and screw plates are now as numerous as the makers engaged in the trade. Nettlefold's sizes of screws are perhaps those best known, but they are worked to a special gauge starting from a diameter of 0·5 inch, which is numbered 32, and which has no known relation to any other gauge used in telegraphy. The microscopical gauge is confined entirely to microscopes. There is, in fact, no fixed pitch, no form of thread, no recognised number of threads per inch, no gauge based on practice and experience. Hence interchangability for repairs is impossible, and the difficulty of indenting for materials from abroad becomes very great. Screws are now generally supplied as "per pattern." Sir J. Whitworth has remedied these defects in the larger forms of machinery, and at the present moment there is not a ship in Her Majesty's navy which is not supplied with the same screws and the same threads. Many large works, such as those at Crewe, are in the same happy condition. Sir J. Whitworth carried his proposed standards for taps and dies to ·100 inch diameter, having 48 threads per inch, but his gauge has not come into general use for sizes less than ·250 inch diameter. I have placed myself in communication with most of the principal electrical apparatus manufacturers in England, and they have not only expressed their willingness to accept a well considered gauge, but have concurred in the view I have indicated of the present unsatisfactory condition of the question.

It fortunately happens that from the point when Sir J. Whitworth and the Franklin Institute start in one direction we can move in the opposite direction, so that not only can the two gauges be made continuous, but though necessarily different in their applications, they can really be made uniform in their character. Indeed, the Whitworth gauge might itself, with slight modifications, be expanded.

It is only necessary for us to consider angular threads square; threads do not enter into such small work.

The Whitworth gauge specifies that the pitch of angular threads shall be equal to the depth which involves an angle of 55°, and that the top and bottom shall be rounded off to one-sixth of the depth.

Screws of a diameter ¼ inch (or No. 4 in the B. W. G.) have 20 threads to the inch. This is the starting point of the American gauge, and both deal with increasing diameter. I propose to start from the same point, but to work in the opposite direction, dealing with diminishing diameters. Thus my starting point is No. 4 C. G. (centimetre gauge) ·251 inch diameter, having 20 threads to the inch.

The exchange of apparatus between this and European countries is now so general that the adoption of the French decimal-metrical system is well worth serious consideration. This is felt so much that in nearly every table of wire gauge the dimensions, both in parts of inches and metres, are given. The adoption of the metre as the unit length would secure adoption of that gauge abroad. The use of the inch as unit leaves us in that singular insular position to which Sir W. Thomson pointedly referred in Section A the other day.

There are two dimensions besides the form and nomenclature to be considered, viz., the diameter of the screw and the number of threads per unit length. I suggest that the nomenclature be that of the wire gauge. The form I again refer to. For the first dimension we might adopt a special number, as is done in the trade now, or we may take the same number for the screw and its diameter in mils. or in millimetres, or, as I propose, we should adopt the new centimetre gauge recommended for adoption by the committee of the Society of Telegraph Engineers (December, 1879).

For the second dimension I propose to take the 5th multiple of the multiple, the number of the screw in the new centimetre gauge as a factor. Thus, No. 5 screw will have 25 threads to the inch, and its diameter will be ·225in. No. 8 screw will have 40 threads to the inch, and its diameter will be ·161in., and so on as shown in the attached table, which embraces nearly all the screws now in use. In all other gauges the number of threads per inch is perfectly arbitrary; in fact, at present, even with the same gauge and the same kind of screw, the number of threads per inch varies.

Thus, if there is any value in my suggestion, we would have a simple nomenclature and a fixed gauge based on that already adopted for wires and plates, and easily remembered.

The attached diagram gives an idea of the character of the thread recommended by me for consideration. It has been carefully prepared with existing threads, and due regard has been paid to the essential requisite of strength, durability, and friction, but in the opinion of some the depth of the thread is too deep in proportion to the diameter of the screw. In the small screws used for telegraphic and electrical purposes we need not consider the difference of metals employed. There can be no doubt that a recognised gauge, baptised with a distinctive name, based on a simple method, and easily remembered, and supplied by such a house as that of Whitworth, would soon take root and be generally accepted if stamped with the requisite authority. I submit that the subject be referred to a committee of the Section for consideration and examination, so that a new gauge be recommended for adoption with the authority of the Association.

* A paper read at the British Association.

ON SOME USES OF FAURE'S ACCUMULATOR IN CONNECTION WITH LIGHTING BY ELECTRICITY.*

BY SIR WILLIAM THOMSON.

The largest use of Faure's accumulator in electric lighting was to allow steam or other motive power and dynamos to work economically all day, or throughout the twenty-four hours, where the circumstances were such as to render this economical, and storing up energy to be drawn upon when the light was required. There was also a very valuable use of the accumulator in its application as an adjunct to the dynamo, regulating the light-giving current and storing up an irregular surplus in such a manner that stoppage of the engine would not stop the light, but only reduce it slightly, and that there would always be a good residue of two or three hours' supply of full lighting power, or a supply for eight or ten hours of light for a diminished number of lamps. He showed an automatic instrument which he had designed and constructed to break and make the circuit between the Faure battery and the dynamo, so as automatically to fulfil the conditions described in the paper. This instrument also guarded the coils of the dynamo from damage, and the accumulator battery from loss.

* Abstract of a Paper read at the British Association.

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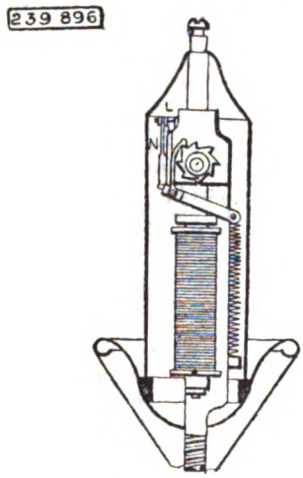
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

239,896. AUTOMATIC ELECTRIC GAS LIGHTING APPARATUS, *Wilhelm Vogel, Freiburg, Baden, Germany, assignor to the firm of S. Dukas, same place.—Filed November 16th*, 1880.

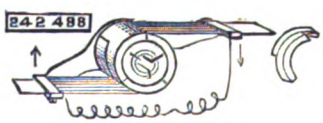
Brief.—There is a primary and a secondary jet, each controlled by a rotary cock connected with the same electro-magnet. When the circuit is closed both cocks are turned and the secondary jet is ignited by a small platinum wire. When the primary jet has been thus lighted, the circuit is broken and the secondary jet shut off. *Claim.*—(1) The combination of the gas burner, elec-



tro-magnet, armature, and electric circuit with a rotary cock, L, having an arm and a rod, N, connecting it with the armature, an outlet, M, adjacent to the burner, and a platinum wire in the circuit opposite said outlet, as set forth. (2) The combination of the gas burner, electro-magnet, armature, and electric circuit with cock K, its ratchet wheel and spring pawl connected to the armature, and the cock L, adapted to be operated by such armature, and having an outlet, M, adjacent to the burner, and a platinum wire in the electric circuit opposite said opening, all substantially as described.

242,488. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES, *Elihu Thomson, New Britain, Conn.—Filed January 10th*, 1881.

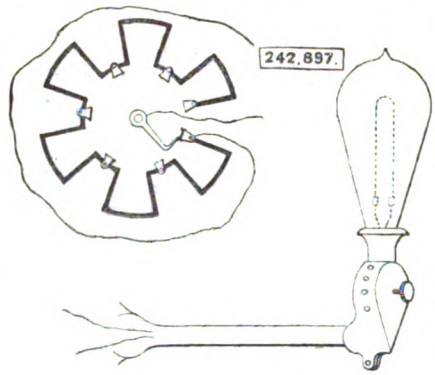
Brief.—By a peculiar construction of the commutator plates, each one of the three plates extends 180 deg. around the commutator. *Claim.*—(1) In a dynamo-electric machine, a commutator containing three or more segmental blocks, substantially as described, each block covering an angle equal to the angular distance of the commutator brushes apart, whereby the armature wire terminals are put into connection with both commutator brushes when at or near the neutral



point. (2) In a dynamo-electric machine, a three-branched armature coil system, the free terminals of which are connected singly to three segments of a commutator ring, each segment covering an angle of 180 deg., substantially as described, and provided with a pair of commutator brushes resting on diametrically opposite portions of said commutator rings. (3) In a dynamo-electric machine, a system of armature coil terminals connected successively to segments of the commutator, and adapted to be put successively into connection with both commutator brushes when at or near the point of neutral polarity, substantially as described.

242,897. INCANDESCENT ELECTRIC LAMP, *Thos. A. Edison, Menlo Park, N.J.—Filed December 15th*, 1880.

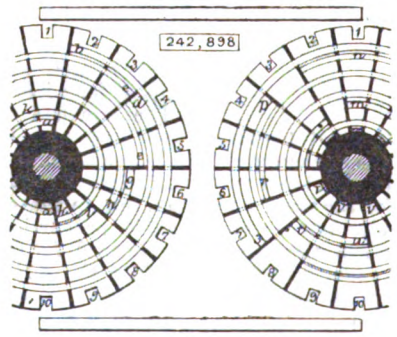
Claim.—(1) The combination, with the incandescing conductor of an electric lamp and the key for controlling the circuit thereof, of an adjustable resistance located within the base of the lamp and cut in or out of the circuit in any desired



proportion by the key, so that the lamp may be used at any desired power less than its normal capacity, substantially as set forth. (2) A carbon resistance made substantially as described, and provided with a series of metallic contacts, in combination with a key having an arm for completing circuit at any desired contact, substantially as set forth.

242,898. MAGNETO OR DYNAMO ELECTRIC MACHINE, *Thos. A. Edison, Menlo Park, N.J.—Filed December 15th*, 1880.

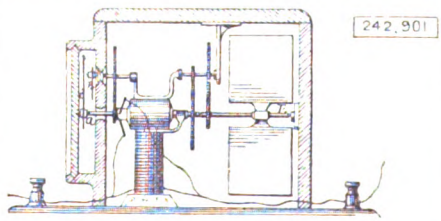
Brief.—Radial bars or plates of conducting material are attached to the ends of the armature, but insulated therefrom and from each other. These plates correspond in number with the bars or coils in which the current is generated, and are



attached thereto in such a manner as to form a complete closed circuit. The connections between the radial plates are by means of curved bars, insulated from all plates except those which they severally connect. The commutator is formed by binding the ends of certain bars at one end of the armature outward at right angles.

242,901. ELECTRIC METER. *Thomas A Edison, Menlo Park, N.J.—Filed March 3rd*, 1881.

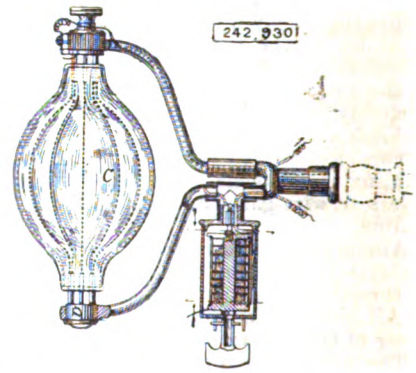
Claim.—(1) The combination, with an electric circuit containing translating devices, of an electro-motor having a definite loading and apparatus for registering the work done, substantially as set forth. (2) The combination of an electric circuit,



an electro-motor, a fan driven thereby, and a registering apparatus, substantially as set forth. (3) The combination of an electric circuit, an electro-motor, a fan or blades driven thereby, a vessel or tank in which the fan or blades are placed, and registering apparatus, substantially as set forth. (4) The combination of an electric circuit, an electro-motor, a fan or blades, a vessel or tank filled with liquid, in which the blades or fan are placed, and registering apparatus, substantially as set forth. (5) An electric meter consisting of a motor having a definite work to perform or loading to overcome, and registering devices, substantially as set forth.

242,930. ELECTRIC LAMP, *Charles A. Hussey, New York, N.Y., assignor, by mesne and direct assignments, to the Hussey Electric Company, same place.—Filed November 20th*, 1880.

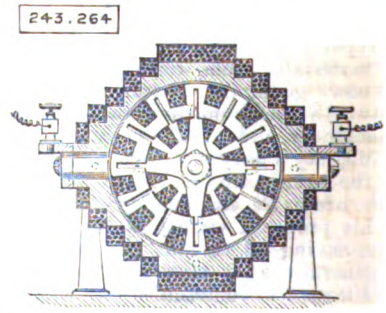
Claim.—The combination, in an electric lamp, of a body capable of being rotated or turned, containing within it two or more independent carbons, and means whereby, when said body is rotated or turned, the ends of the carbons are shifted to bring the carbons successively into the electric circuit substantially as specified. (2) The combination, with an electric lamp, of a stationary contact piece and a number of resistance devices arranged upon a common support, which



may be rotated to bring said resistance devices into the circuit of the lamp to vary or extinguish the light, substantially as specified. (3) The combination with an electric lamp of a rotary spool furnished with coils of fine wire, and means, connected with the circuit of the lamp, whereby, on the rotation of the spool by a hand piece, more or less of its coils may be thrown into the lamp circuit, and the resistance in the circuit varied, substantially as specified.

243,264. DYNAMO-ELECTRIC MACHINE, *Charles A. Hussey, New York, N.Y., assignor, by direct and mesne assignments, to the Hussey Electric Company, same place.—Filed October 23rd*, 1880.

Brief.—The armature is completely inclosed in a hollow field magnet, whose exciting wire is wholly external to the field magnet. *Claim.*—(1) An electro-magnet composed of a core of internally circular, cylindric, or analogous form, and wire wound over its exterior, without passing through its interior, from end to end, and inclosing it, save at certain places designed to form poles or consequent points, substantially as



set forth. (2) An electro-magnet composed of a core of internally circular, cylindric, or analogous form, provided, save at certain places designed to form consequent points, with external ridges and wire wound over the exterior of the core on said ridges, but not through the interior of the core, substantially as set forth. (3) An electro-magnet composed of a core of internally circular, cylindric, or analogous form, provided, save at certain places designed to form consequent points, with external ridges disposed spirally or angularly, and wire wound over the exterior of the core on said ridges, but not through the interior of the core, substantially as set forth.

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TELEGRAPH SHARE LIST.

Companies.	Closing Prices Sept. 21.		Business Done Week Ending Sept. 21. Highest.	Lowest.
Anglo-American	51¼,	52¼	52¼	49¾
Do. Deferred	82,	¼	82½	79¼
Do. Preferred	23¾,	24¼	24½	23¼
Brazil Submarine	10 13-16,	15-16	11	10¾
Cuba	9¼,	10	—	9¼
Do. Preference	16¼,	17	—	—
Direct Spanish	5,	¼	—	—
Do. Preference	14¾,	15¼	15¼	14¾
Direct United States Cable	10¾,	¼	10¾	¼
Eastern Telegraph	10¼,	¾	10¾	10¼
Do. 6 per Cent. Preference	13,	¼	13¼	12¾
Do. 5 per Cent. Debentures, 1899	105,	8	—	—
Eastern Extension	10¾,	11¼	11	10¾
German Union	10¼,	¼	10½	10
Globe Telegraph and Trust Company	6 7-16,	9-16	6½	¼
Do. Preference	12¼,	½	12½	¼
Great Northern	12¼,	½	12½	12¼
Indo-European	28,	29	—	—
Mediterranean Extension	2¼,	3	—	—
Do. Preference	9¼,	¾	—	—
Reuter's	12,	13	12½	—
Submarine	280,	290	—	—
West India and Panama	1¼,	¼	1¾	—
Do. 1st Preference	7,	¼	7¼	—
Western Brazilian	7¼,	¼	7 11-16	¼
West. Union 7 per Cent. 1st Mortgage	125,	130	—	—
Do. 6 per Cent. Sterling Bonds	104,	107	—	—

KING'S COLLEGE, LONDON.—EVENING CLASSES IN ELECTRICITY AND ITS VARIOUS APPLICATIONS.—These classes, which are held on Wednesday evenings, from 7 to 8, under the direction of R. E. DAY, M.A., Author of "Exercises in Electrical Measurement," &c., will OPEN on WEDNESDAY, October 12th, at 7 p.m.

The instruction will be specially adapted to meet the requirements of students who are preparing for the Prel. Sc. and First B.Sc. Examinations at the University of London.

The fee for the course, from October to Easter, is £1 11s. 6d., payable in advance in the College office.

UNIVERSITY COLLEGE, NOTTINGHAM.—The SESSION COMMENCES early in OCTOBER.—The Prospectus may be had on application to the SECRETARY.

BIRKBECK INSTITUTION.——EXPERIMENTAL PHYSICS.

Mr. W. J. WILSON, F.C.S., M.S.T.E., will commence a COURSE of about sixty EXPERIMENTAL LECTURES on ELECTRICITY, MAGNETISM, SOUND, LIGHT, and HEAT, on FRIDAY, October 7th, at 8 p.m.; to be continued on succeeding Fridays at the same hour, terminating with the Government examinations in May. Fee for the course, 8s. For detailed syllabus, &c., apply to the LIBRARIAN.

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Fuel and Illuminating Agents	Fridays.
Metals and Metallic Compounds	Mondays.

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Laboratory	Tuesdays.

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Electrical Laboratory Apparatus	Fridays.

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Laboratory	Thursdays.

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Bricklaying	Monday Evenings.
Carpentry and Joinery	Tuesday and Friday Evenings.
Stonemasonry	Wednesday and Friday Evenings.
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House Decoration	Wednesday Evenings.
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Apprentices admitted to these Trade Classes at a registration fee of 2s.

Further particulars with respect to any of these Courses can be obtained on application at the Schools, or from the Director and Secretary of the Institute, Gresham College, London, E.C.

PHILIP MAGNUS, Director and Secretary.

CITY and GUILDS of LONDON INSTITUTE. TECHNOLOGICAL EXAMINATIONS.

The next EXAMINATIONS in TECHNOLOGY will be held at the different Provincial Centres throughout the Kingdom on the evening of May 24, 1882.

Teachers desiring to form classes should apply at once to the Director and Secretary of the Institute.

List of subjects in which the examinations will be held and general conditions of payment on results, can be obtained by application to the

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SLIP

THE TELEPHONE IN QUEBEC.—It is stated that all the capital required by the Compagnie de Téléphone de Quebec has been subscribed.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this company for the week ended 23rd inst. amounted to £2,993.

KING'S COLLEGE.—Evening classes in electricity and its applications will be held at this college on Wednesday evenings, beginning on the 12th October.

THE EDISON DYNAMO-MACHINE.—The great dynamo-machine has at length arrived in Paris. It will, however, be several weeks before it is finally in place.

ELECTRIC LIGHT AT ABERDEEN.—The Swan incandescent lamps have been on exhibition at Aberdeen, in the hall devoted to the exhibition of gas appliances.

ELECTRIC LIGHT IN MANCHESTER.—We hear that the British Electric Light Company have the contract for lighting the Royal Exchange in Manchester.

THE TELEPHONE IN SYDNEY.—The various fire-brigade stations of Sydney and suburbs are to be connected by telephonic communication. The cost is estimated at about £800.

PROPOSED CABLE TO THE CANARY ISLES.—A Reuter's telegram dated Madrid, the 28th of September, says:—The Spanish Government contemplates laying a cable between the Canary Islands and Spain.

SOUTH AMERICA.—The cable between Rio Grande do Sul and Monte Video is again interrupted. Messages for Uruguay, Argentine Republic, Bolivia, Chili, and Peru will be delayed by this interruption.

EFFECT OF HEAT ON THE COMPASS.—It is stated that during the intense heat which has recently been experienced in America the compass was found to stay in any position in which it might be placed without reverting to the north.

INTERNATIONAL ELECTRICAL EXHIBITION.—We hear that M. Cochery is disposed to keep the Exhibition open until December if the foreign Commissioners desire it, and will provide the building with heating apparatus for the cold weather.

THE TELEPHONE IN INDIA.—It is stated that the Oriental Telephone Company has arranged terms with the Government for the introduction of telephone exchanges into the three Presidencies, and now only awaits the issue of licences, which are nearly ready.

ELECTRIC LIGHT AT MIDDLESBORO'.—This town which, fifty odd years ago was not in existence, is celebrating its jubilee. The streets, or some of them, are to be lit by 64 Brush lights, supplied and erected by Messrs. Hammond and Co., in honour of the event.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this company for the week ending September 23rd, 1881, amounted to £1,838, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

ELECTRIC LIGHT AT THE BRITISH MUSEUM.—In addition to the four Siemens arc lamps that have done good service in the reading room of the British Museum in the past, the approaching winter months will witness the introduction of Swan's incandescent lamps into the cloak rooms and lavatories.

ELECTRIC LIGHT FOR GLASGOW HARBOUR.—It is probable that before long Glasgow Harbour will be lit by electric lamps. In the meantime, arrangements are being made for experimenting with the electric light at the Salterscroft Graving Dock, Govan, which belongs to the Clyde Navigation Trustees.

ANGLO-AMERICAN TELEGRAPH COMPANY.—The directors of this company have resolved, after placing £37,500 to the renewal fund, to declare an interim dividend for the quarter ending September 30 of 15s. per cent. on the ordinary stock, and 1½ per cent. on the preferred stock, both free of income tax, payable on November 1.

ELECTRIC LIGHT IN WARRINGTON.—The offices of the *Warrington Guardian* were lighted up last week for the first time by Brockie lamps, supplied by the British Electric Light Company. They are said to have given great satisfaction. This paper has also telephonic communication between its offices and printing works.

PRICES.—The prices as quoted this week are, for gutta percha per lb.:—Genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber, fine Para, 3s. 3½d. to 3s. 4d.; negro-head, 2s.; central American, 1s. 5d. to 2s. 2½d.; Assam and Pegu, 8d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 5d. to 2s. 2d.

TELEGRAPHS IN NORTH AFRICA.—A *Times* telegram says that a submarine cable is being laid between Galle and Bizerta, which will ensure communication with Europe without liability to the line being cut by native tribes, as has frequently happened to the land wires since the disappearance of the superstitious dread which formerly protected African telegraphs.

ELECTRIC LIGHT FOR NIGHT WORK.—The *New York Hour*, speaking of the use of the electric light as a means of enabling the work of constructing a certain building to be carried on by night as well as day, says:—"Rather more work is done at night than in the day time, because of the lower temperature, and because the workmen are not distracted by passing sights and sounds."

NEW CABLE TO ICELAND.—Further details with regard to this proposed new cable which is to be laid between Thurso, in Caithness, and Iceland, passing by the Faroe Islands, state that the chief office in Iceland will be at Reikavik, and the line will connect with Stappen, the chief town of the Vester-Amt, and with Madruvel in the Norder-Amt. The plans and estimate have already been prepared.

THE BLOCK SYSTEM FOR FRENCH RAILWAYS.—Our contemporary *L'Electricité*, in its issue of the 24th inst., gives a description of the block system of signalling in English railways, and concludes by expressing a hope that the system of *laisser faire* so long prevailing in France will soon disappear, and that, bearing in mind the numerous accidents which have lately occurred on the French railways, the Government will take the matter up without delay.

INTERNATIONAL ELECTRICAL EXHIBITION.—THE JURY.—In our issue of the 17th September we gave the numbers of the jurymen appointed to represent each country. We now give the names of the English members, viz.:—Mr. Warren Delarue, Major Armstrong, R.E.; Mr. Shelford Bidwell, Mr. Crampton, M.S.T.E.; Mr. Crookes, F.R.S.; Professor Everitt, F.R.S.; Professor Forbes, Mr. J. F. Moulton, F.R.S.; Mr. W. H. Preece, F.R.S.; and Mr. A. Stroh.

ELECTRIC LIGHT FOR BLAST FURNACES.—Large blast furnaces are great consumers of gas, and until recently it was supposed that the electric light could not be so arranged as to give good lights on the gantry between the furnaces. We hear, however, that the Newport Iron Works, Middlesbro', the Aireside Hematite Iron Company, Leeds, and the Mostyn

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Coal and Iron Company, Mostyn, have been successfully lighted by Messrs. Hammond and Co. with the Brush light.

Telegraph Stores Wanted.—The Directors of the Lancashire and Yorkshire Railway require tenders for the supply of india rubber, telegraph fittings, telegraph wire, &c. Further particulars and forms of tender may be obtained on application at the Stores Department, Miles Platting, near Manchester. Tenders are to be addressed to the Directors, and lodged with the Secretary, Mr. J. H. Stafford, Hunt's Bank, Manchester, not later than 10 a.m. on the 10th of October.

Electrical Recorder of Minute Time Periods.—At the meeting of the French Academy of Sciences on the 19th of September, M. Gustave Noel described an apparatus for recording physiological periods, or periods of time of minute duration. The apparatus is composed of a needle actuated by a Villarceau regulator, which traverses a dial plate in one second. The needle is set in motion at the commencement of the experiment, and stopped at the end by means of a small electrical interrupter.

The Globe Telegraph and Trust Company.—The directors have resolved to declare the following interim dividends for the quarter ending 18th October, 1881, viz:—3s. per share on the Preference Shares (being at the rate of 6 per cent. per annum), and 2s. per share on the ordinary shares (being at the rate of 4 per cent. per annum), both free from income tax, and payable on and after the 18th prox. The transfer books will remain closed from the 11th to the 18th October, both days inclusive.

Eastern Extension Telegraph Company.—The Eastern Extension, Australasia, and China Telegraph Company (Limited) announce that their accounts to June 30 last, subject to audit, show a balance of profit of £94,755 10s. 10d. for the half-year. Out of this the board have already paid one interim dividend of 2s. 6d. per share, and they have now declared another of like amount for the quarter ended June 30, besides a bonus of 1s. per share, making a total payment of 3 per cent. for the half-year. A balance of £34,830 is carried forward.

Distant Effects Produced by Lightning.—M. René Thury, of Geneva, has made observations on the induced currents produced by lightning flashes at a distance from the place of observation. He stretched a metal wire between the roofs of two houses, one end of which was put to earth, and the other connected with a telephone. Each time that a flash was observed at a distance, sometimes estimated to be as much as 40 kilometres, a characteristic sound was heard in the telephone at the exact instant of perceiving the light of the flash.

Electric Lighting by Water Power.—An experiment was made at Godalming, on Monday night last, to light a portion of the town by electricity, the motive power being obtained from a water wheel. One large Siemens lamp and several of Swan's small incandescent lights were in use, and the results were deemed satisfactory. It is proposed to fix turbines, which the river Wey will drive at considerable velocity, and so to give the necessary power for supplying a number of lights for the Charterhouse Schools, Godalming, and some at Guildford also.

Another Telephonic Concert.—The other day a concert by telephone was given at the Science and Art School, Oldham. The players were stationed in York-street, Manchester, the telephonic despatch office of the *Oldham Evening Express*, and the songs and instrumental music were most clearly heard at Oldham, having been transmitted along twelve miles of wire. We noticed the completion of this telephone line some weeks ago. It has been erected by Messrs. D. Moseley and Sons, of Manchester, and the transmitter is one recently patented by them.

Telegraphs in Costa Rica.—In his report on Costa Rica Consul Meugens writes under date San Jose, 18th March, 1881, as follows:—"By virtue of a treaty concluded with Nicaragua, about fifty miles of wire has been laid from Liberia to the frontier, thus opening telegraphic communication with that Republic on reciprocal terms. A line has also been opened between the districts of Nicoya and Liberia, and Mr. Keith has brought telegraphic communication from Limon to Destierro, a distance of forty miles, which line will be continued to the capital in the course of a few months."

The Pic du Midi Observatory.—*Nature* says:—"The building of the Observatory of the Pic du Midi has been completed on the very top of the mountain, at an altitude of 2,600 metres. The old building, which was placed in a valley at a less elevated situation, will be used merely as a station for travellers. General Nansouty is now busy fitting the establishment with apparatus and victuals for next winter, as, according to every probability, it will be blocked by snow during more than six months. The storms are so heavy that no less than six lightning conductors have been established for protection."

Electricity and Flowers.—M. Laroque, in a note to the Academy of Sciences at Paris, mentions a curious phenomenon noticed by him during a thunderstorm on the 25th of June last, which took place at Montmaurin, in Haute-Garonne, France. He noticed that one of a tuft of lilies (the tallest of them) was surrounded by a diffuse, purple-coloured light, which formed an aureola round the corolla. This light lasted 8 or 10 seconds. When it had vanished he approached the lily, and found, to his great surprise, that it was totally deprived of its pollen, whilst the surrounding flowers retained theirs. The electric fluid had scattered it.

The Telephone in India.—Advices from Calcutta state that the use of the telephone is extending rapidly in India. It is used in several instances in Bombay, and one of the large steamship companies in Calcutta is arranging for telephonic communication between their ships at the moorings and the offices in town. Pieces of cable will be used to connect the ships with the shore, the ends of the cables will be fastened to the buoys, and on a ship mooring she will be placed in telephonic communication with the office at once. On the great Indian canals, too, the telephone is, it is said, likely soon to be set up, thus enabling engineers to regulate the supply of water with greater certainty than at present.

The Aggrieved Telegraphists.—During the present week several of the larger telegraph establishments, including that of the London Central Office, have received their promotions under the revised scheme. As was to be expected, the apportioning of good things has not given entire satisfaction in every case; but, on the whole, there is reason to believe that the prevailing discontent has now been appeased. The promotions date back from April, and overtime performed since the 1st of June is to be paid for under the new system. The senior officers have not been overlooked, but compared with the rewards given to their importunate subordinates the improvements in the higher grades are insignificant. This is said to be notably the case in respect to the female officers.

Electric Lighting on Shipboard.—The two Spanish cruisers, Gravina and Velasco, now approaching completion by the Thames Iron Works and Shipbuilding Company Blackwall, are to be fitted with large electric lights for

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"search" purposes, such as are now being extensively employed in the British and many foreign navies. The arrangements consist in each case of a large Gramme machine, driven by one of Hodson's rotary engines, these being fitted in the main engine room. The current is conveyed to suitable lamps, fitted with improved reflectors, the light given being one of great intensity, equal to 20,000 candle power. The work is being carried on by the British Electric Light Company (Limited). It is also in contemplation to light up some of the cabins with incandescent lamps.

THE ELECTRIC LIGHT.—The Rev. G. H. Staite writes in a recent number of *The Times* as follows:—"May I be allowed to state that the first public exhibition of the electric light in this country was given by Mr. W. E. Staite in Sunderland in 1847, and that on November 2, 1848, a paragraph in *The Times* stated:—'Some very interesting and important experiments were exhibited in the great room of the Hanover-square Rooms to prove the power and efficacy of the patented electric light, of which Mr. W. E. Staite is the inventor. The results were as favourable as could be wished by the inventor, and certainly surpassed the expectations of those who were assembled to witness them. . . The power is immense, resembling sun or day light, and obscuring the light of candles in the manner that rays of daylight obscure them.' In the following year the Academy of Sciences in France awarded priority of invention in improvements in electric lighting to 'an English engineer named Staite,' as reported in *Le Courrier Français* Feb. 4, 1849."

HUGHES'S INDUCTION BALANCE.—The Paris correspondent of *The Times* contributes an interesting fact tending to show the reliance that may be placed on Professor Hughes's induction balance in operations for finding metal in the human body. We quote his words, which are as follow:—"Mr. Elisha Gray, of America, whose name is so well known in connection with the telephone and the harmonic telegraph, was a disbeliever in the utility of the induction balance as a surgical appliance. He said to Professor Hughes, 'Thirty years ago, when working at some metal-work, a filing of iron entered my finger; the more I tried to extract it the deeper it went in. I believe it is still there; and if your instrument is of any value, you ought to be able to tell me in which finger it is.' Professor Hughes tested Mr. Gray's fingers; none of them gave any sound until he came to the forefinger of the right hand, when the balance of the coils was quite destroyed and a noise was given out. This was the very finger in which the filing was buried 30 years ago. I need hardly say that Mr. Gray was completely convinced."

THE CATALOGUE OF THE ELECTRICAL EXHIBITION.—Commenting on the Paris Exhibition, the *Saturday Review* expresses its opinion that "the French Government, and it alone, is to blame for allowing the Exhibition to be so badly catalogued; and, above all, for granting the concession for printing and selling the catalogue to a private speculator, who has added to it under the cover of the title 'Catalogue Général Officiel,' and the heading of the title-page, 'Ministère des Postes et des Télégraphes,' some most shameless puffs of some of the exhibits, one in particular being repeated several times under different forms. Imagine an official catalogue published under the authority of a Minister of State containing such a statement as this—a statement made before the jury had even been appointed:—'L'Exposition d'Edison est certainement la plus importante, la plus nombreuse, et la plus variée de tout le Palais de l'Industrie.' And again, in the face of the wide-spread knowledge of the true history of incandescent lighting, this official ministerial catalogue going on to say:—'Edison est le premier qui ait fait usage, et ses brevets en font foi, d'un filament de charbon incandescent *continu*, avec une résistance supérieure à dix ohms, dans un vide maintenu par un globe de verre *continu*, dans lequel on scelle les conducteurs métalliques.'"

ELECTRIC LIGHT FOR AUSTRALIAN LIGHTHOUSES.—Some interesting experiments were made in public last week at the well-known glassworks of Messrs. Chance Brothers and Company, Smethwick, near Birmingham, with a new lamp, which they have just constructed to crown the summit of the South Head Lighthouse, Macquari Harbour, Sydney, New South Wales. It is called a first order, dioptric, revolving light, with the electrical arc. The lamp has a special arrangement of prisms for securing vertical divergence of the beam. It is over 6ft. in diameter, and the height is about 9ft. It is said to be the first time such dimensions have been applied to illumination by the electric arc. The lamp or regulator has a power of about 12,000 candles in the focus of light, and the merging beam has a luminous intensity exceeding 12,000,000 candles. The light will give flashes around half the horizon at intervals of a minute, and will make a complete revolution every 16 minutes. On an average the light will be visible at a distance of 40 or 50 miles. The lamp was designed for Messrs. Chance by Dr. Hopkinson, F.R.S., and is constructed for the Government of New South Wales. Its makers claim that it will be the largest and most powerful light in the world. The experiments are stated to have been thoroughly successful, the light being so intense that it could hardly be endured with the naked eye.

THE FIRST YEARS OF THE TELEGRAPH IN FRANCE.—M. Algave has communicated an article to a recent number of the *République Française*, in which he gives a few historical memoranda of the introduction of the telegraph into France. It appears that in 1842 M. Foy came over to England to see what was being done by Cooke and Wheatstone, but that nothing came of his journey. In the meantime, however, Wheatstone himself established the first telegraph line in France for the St. Cloud and Versailles Railway, and another for the Orleans Railway. He then tried to convince the Government that he could transmit messages with ease between Paris and Havre, but they would not believe him, and also informed him that his patent rights were of no use in a country where the State had the monopoly of the telegraph. Wheatstone, therefore, returned home discouraged. In 1844 the Government sent a commission to report on the working of the telegraph in England, and as to the applicability of the system there in use in France. A credit of 240,000 francs was voted to this commission, which comprised amongst its members such well-known names as Arago, Pouillet, and Becquerel. On the 30th of January, 1845, the work of erecting a line on the railway between Paris and Rouen was begun, and on the 4th of May following communication was established, the work having been carried on under the supervision of MM. Breguet and Gounelle. On the 11th of of June following official experiments were carried out. M. Breguet operated at Rouen, and the commission awaited the result at Paris. A needle placed between the poles of a horse shoe electro-magnet was the apparatus used. Several sentences were telegraphed between M. Breguet and the Commission. The time occupied in transmitting these sentences was, according to the report subsequently published by the commission, about the same as it would have taken to write them by hand in moderately large letters. The development of the telegraphic system was very slow, however, until the year 1853, when it prospered under a new director of telegraphs.

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THE ELECTRICAL EXHIBITION AT PARIS.

Miscellaneous Exhibits.

Instruments of Precision, Resistance Coils, &c.

For many years Messrs. Elliott Brothers have held a very high position as makers of apparatus for scientific work, their careful construction and good workmanship in the production of the instruments for electrical science having in no small degree contributed to establish this great reputation. It was to be expected, then, that the exhibits of Messrs. Elliott at Paris would be of an interesting character, and fairly represent work of this kind as it is done in England; and we are bound to say that the collection of apparatus is one

Fig. 1.

of the finest in the exhibition. We shall see that the instruments are by no means made to a hard-and-fast design, but that modifications are introduced whenever experience shows that such modifications are beneficial. It requires a somewhat close

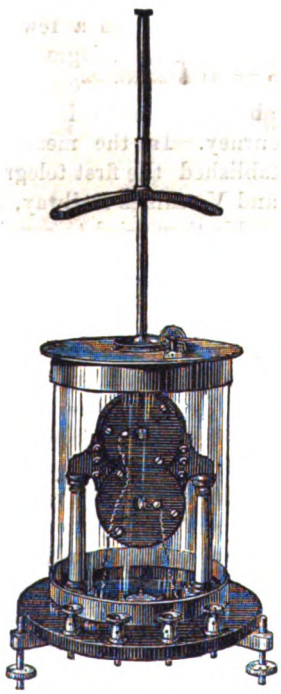

Fig. 2.

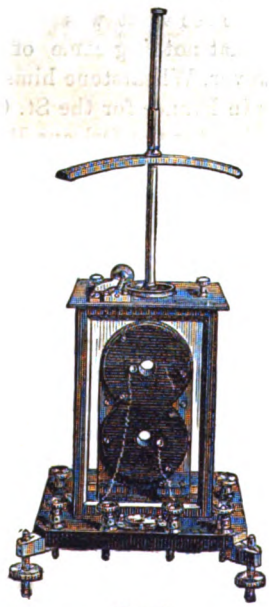

Fig. 3.

examination to ascertain these minor alterations, and still closer examination to know the why and the wherefore of each modification. Without any very lengthy description of these instruments, the general types of which are mostly well known; we shall notice the changes referred to, and when possible the reasons for introducing such changes. The instruments are placed on tiers, the lower one being filled principally with resistance coils. The next tier is principally filled with galvanometers of various forms, but almost all according to the designs of Sir W. Thomson. The discovery of Œrsted in 1819 was the commencement of the investigations which ultimately led to this beautiful instrument. He noticed the influence of a current on a magnet. In 1820 Professor Schweigger, of Halle, utilised this discovery in making an instrument termed an electro-magnetic multiplier. This was really the first rough form of galvanometer. All galvanometers are founded on the principle of Schweigger's multiplier, in which the current is made to pass through a wire, which is coiled so as to pass many times round an open space, within which a magnet is suspended, where therefore is developed an electro-magnetic force, the intensity of which is indicated by the magnet. In sensitive galvanometers the coil is so arranged that its windings occupy the positions in which their influence on the magnet is greatest. They are, therefore, packed closely together in order to be near the magnet. In constructing a sensitive galvanometer the aim is to make the field of electro-magnetic force in which the magnet is suspended as intense as possible.

Clerk Maxwell, writing of the galvanometer, says it is an instrument which indicates the strength of an electric current by its magnetic effects. Galvanometers in general consist of one or more coils of silk-covered wire, within which a magnet is suspended with its axis horizontal. When a current is passed through the wire the magnet tends to set itself with its axis perpendicular to the plane of the coils. If we suppose the plane of the coils to be placed parallel to the plane of the earth's equator, and the current to flow round the coil from east to west in the direction of the apparent motion of the sun, then the magnet within will tend to set itself with its

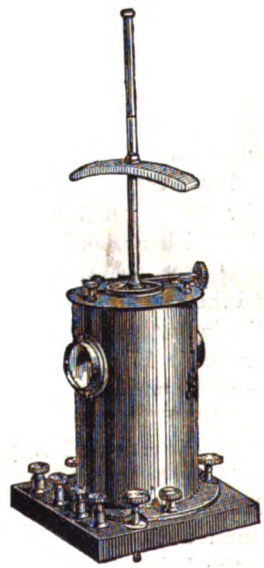

Fig. 4.

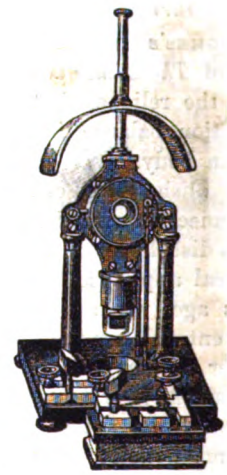

Fig 5.

magnetisation in the same direction as that of the earth considered as a great magnet, the north pole of the earth being similar to that end of the compass needle which points south.

The best examples of such instruments are those introduced by Sir W. Thomson, as constructed by Messrs. Elliott. Fig. 1 shows the tripod nonastatic form. In this the small magnets in the coil are cemented to the back of a very light mirror, and are usually about $\frac{1}{8}$in. in length. A scale and source of light are used with these galvanometers. The light impinging on the mirror in its normal position is reflected back to the zero of the scale, and to the right or left when the mirror, or rather magnets, move under the influence of a current through the coil, the reflected light, of course, obeying the angular law of light reflection. The mirror and magnets are hung by a single fibre of unspun silk. To avoid the inconvenience of having to place the apparatus always in the magnetic field, a large curved magnet feebly magnetised is supported horizontally on a vertical stem at the top of the case. The directive force of this magnet enables the experimenter to make an artificial meridian in any desired direction.

The astatic form is shown in Fig. 2, each needle being surrounded by its own coils. Fig. 3 shows another form of this

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instrument, the difference being that the glass case is square instead of cylindrical, and it is easier to replace such glass should breakage occur. Fig. 4 shows an instrument surrounded by a brass case, so as to avoid risk of breakage when travelling. In principle these instruments are alike.

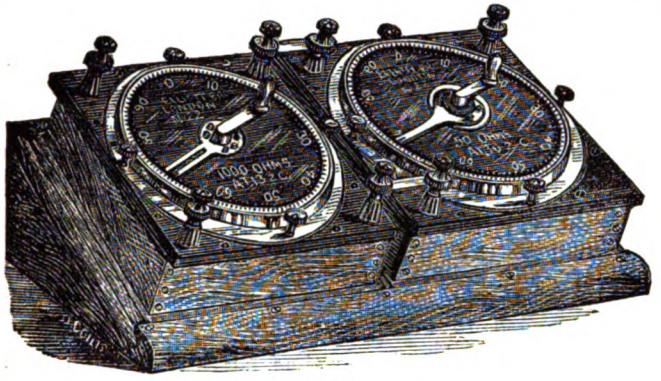

Fig. 6.

Recently the cases containing the coils have been made hinged, so that it is easy to come at the coils if required. In Fig. 5 an oil jar is shown, by means of which the vibrations of the needle are able to be checked, and the needle soon brought back to a state of rest.

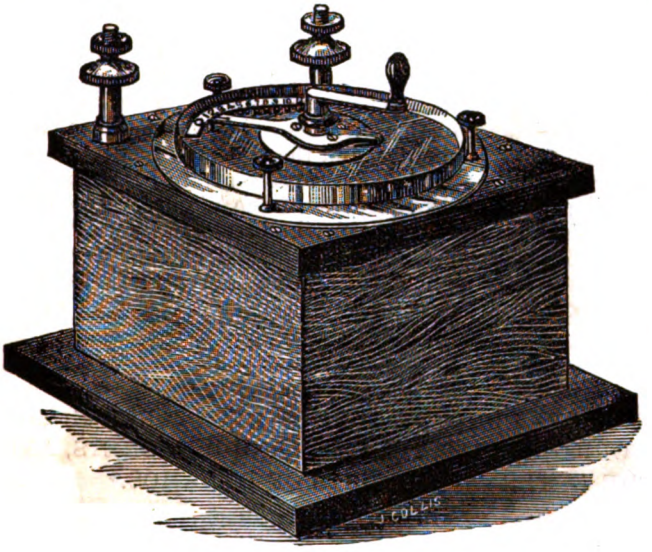

Fig. 7.

A fine instrument used principally for cable work is the circular sliding resistance coils, shown by Messrs. Elliott Bros. This resistance box was originally designed by Sir W. Thomson and Mr. C. Varley. The instrument is herewith

platinum iridium, and on the under side of the contact lever are small plates of gold, so that the contact is made between gold and platinum iridium.

On the same principle as the above is the sliding shunt apparatus, used with marine galvanometers, having a total

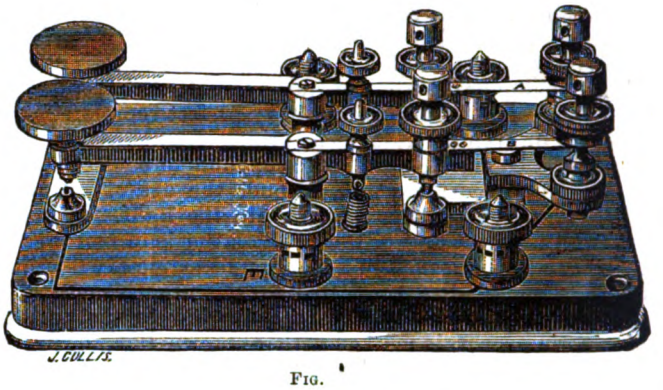

Fig.

of 300,000 ohms resistance. This resistance is divided into eleven parts, so that a shunt can be arranged from 1-1,000th to equality. Fig. 7 gives an illustration of this instrument.

Figures 8 and 9 show a very efficient form of signalling key for cables, specimens of which are exhibited by Messrs. Elliott Bros., also by Messrs. Clark, Muirhead, and Co. In addition to front and back contacts similar to those in a Morse key there are two spring contacts to each lever, at F H and E G. The connections are so arranged that these contacts are supplementary, so that to the rigid play of an

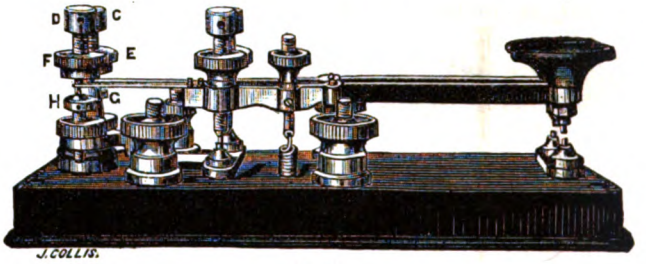

Fig. 9

ordinary key is added the advantage of long, steady, and rubbing spring contacts, capable of ready adjustment. This key is used on all cables in the Eastern system of any length to the exclusion of other forms, which experience has amply justified. The key has been made to the design of Mr. H. Saunders, chief electrician of the Eastern Telegraph Company.

Besides Saunders' key, Messrs. Elliott show Dickenson's key with reversing switch (Fig. 10). As will be seen from the illustration, a brass cap is fitted over the terminals to protect them from dust, &c. This key is used for cable work,

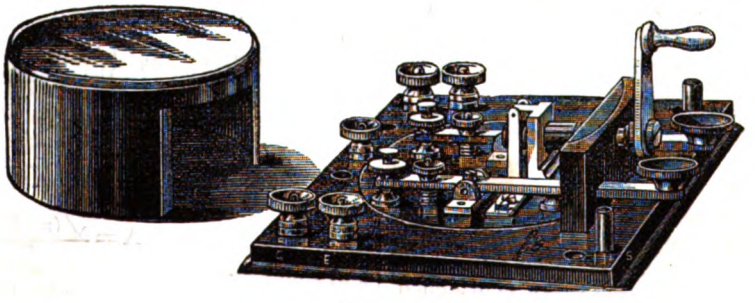

Fig. 10.

illustrated (Fig. 6.) The coils are wound with platinum silver wire. Each coil, on the one side being, or each of their 101 studs representing, 1,000 ohms; on the other side each of the 100 studs represents 20 ohms. The studs are made of

either with mirror or recorder. The switch is turned over to one side for sending, and when the message is finished the operator turns the switch over to the other side for receiving.

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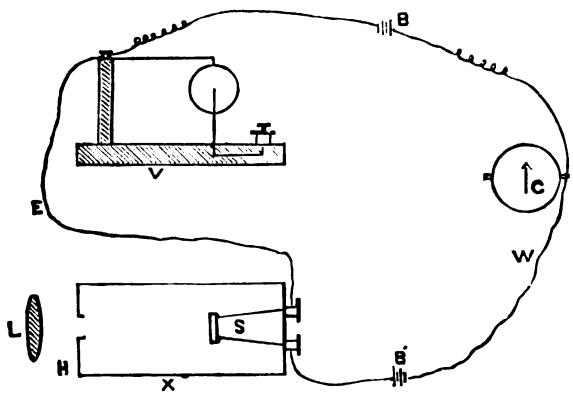
TELEGRAPHIC PHOTOGRAPHY.*

BY T. SHELFORD BIDWELL, M.A.

It may be well to state at the outset that the apparatus described is merely of an experimental nature. Its object is to demonstrate the possibility of transmitting pictures of natural objects to a distance by telegraph. Hitherto only simple designs in black and white have been transmitted. By adopting a system of development similar to that used in ordinary photography the apparatus might, perhaps, be rendered capable of transmitting a very perfect reproduction of landscape or even portrait. The principle employed is, first, the use of a colourless chemical compound, to be decomposed by an electric current; and, second, the use of selenium, which varies in resistance according to the light. Bain and Blakewell used the first of these; the latter is of more recent discovery. Paper soaked in a solution of iodide of potassium laid on a metal disc connected to the negative pole of a battery, having a platinum wire connected to the positive pole drawn over it, is marked with a brown line, owing to liberation of iodine. The brown line is continuous so long as the electric circuit is complete, but when the circuit is broken the line is not obtained. Blakewell's process consists of two parts, the sending and receiving apparatus. The former has the figure to be transmitted drawn in non-conducting ink on a piece of tin foil; the latter consists of a metal plate and sensitised paper, with a platinum point travelling over it. Whenever the point of platinum at the sending station passes over the conducting surface a corresponding brown line is made at the receiving end, when it passes over the non-conducting surface electric contact is broken, and no chemical action occurs at the receiving end; thus the figure appears at the receiving end as a white design on a brown background.



The apparatus designed by Mr. Bidwell is smaller in principle to Blakewell's, but the method of transmission differs, inasmuch as the pictures intended to be transmitted are not mere artificial drawings, but the images of the objects themselves focussed on a little screen. This mode of operation depends on the sensitiveness of the selenium.

The receiving instrument is shown at Y. It consists of a platinum-covered brass cylinder, 2in. long and about $\frac{1}{8}$in. diameter, mounted horizontally on a spindle 7in long. One of the projecting ends of the spindle has a screw cut upon it of 64 threads to the inch, the other end is left plain. The spindle revolves like that of a phonograph in two brass bearings, the distance between which is equal to twice the length of the cylinder, and one of the bearings has an inside screw corresponding to that upon the spindle. An upright pillar fixed midway between the two bearings, and slightly higher than the cylinder, carries an elastic brass arm, fitted with a platinum point, which presses normally upon the surface of the cylinder. To the brass arm a binding screw is attached, and a second binding screw on the stand is joined by a wire to one of the brass bearings. The + pole of a local battery, B, is connected through a set of resistance coils, R, with the platinum point and the — pole through a galvanometer, G, with the metal cylinder. The cylinder is covered with sensitive paper, and rotated, when, if a current passes, the platinum point traces a close spiral line. The intensity of the line varies with the strength of current, and, of course, if there is no current there is no line. By this means a picture may be reproduced. The current is regulated by the action of the luminous focussed image upon a piece of prepared selenium in the transmitting instrument. At the transmitting station is a battery, B^1, connected by two line wires, W and E (one of which can be replaced by earth), with galvanometer and receiving instrument. The current from B^1 passes in *opposite* direction to that from B. These currents neutralise, or decrease each other according to the equality or difference between them. In the circuit of B^1 is the transmitting instrument X, intended to regulate the current as desired. The current passes through selenium cells, enclosed in a small box from which light is excluded, except such as can pass through a small pinhole drilled in the side of the box. The box is arranged to move perpendicularly up and down through 2in., and at the same time laterally through $\frac{1}{64}$in. If a picture, not more than 2in. square, is projected by the lens L on the side of the box with the pinhole, the pinhole in due time passes over every point of the focussed image. The box of the transmitting instrument and the cylinder of the receivers are made to move synchronously. To prepare for work the pinhole of the transmitter is brought to the brightest part of the focussed image, the resistance R is then adjusted so that the currents from B and B' balance each other, as shown by G, the cylinder receives its sensitive paper, when the box and cylinder are moved to their extreme positions. The spindles are caused to revolve uniformly, and the picture is gradually transmitted. When the pinhole passes by a dark part, the resistance of the selenium cell is increased, the current from B predominates, and the platinum point traces a dark brown line upon the paper; the contrary happens when the hole passes the bright parts of the picture. The close spiral line thus described with the breaks in its uniformity constitutes the picture, which, if the instruments were perfect, would be a mono-chromatic counterpart of that projected upon the transmitter.

* A paper read at the Paris Meeting of the Society of Telegraph Engineers, Sept. 24, 1881.

THE PROPER PROPORTIONS OF RESISTANCE IN THE WORKING COILS, THE ELECTRODE MAGNETS, AND THE EXTERNAL CIRCUITS OF DYNAMOS.*

BY SIR WILLIAM THOMSON.

For the electro-magnet—

Let L be the length of the wire,
B ,, bulk of the whole space occupied by wire and insulation,
n ,, ratio of this whole space to the bulk of the copper alone (that is, let $\frac{1}{n}$ B be the bulk of the copper),
A ,, the sectional area of wire and insulator,
R ,, the resistance of the wire.

For the working coil, let the corresponding quantities be L', B', n', R'. Lastly, let s be the specific resistance of the copper. We have

$$B = A L$$

$$R = n s \frac{L}{A} = n s \frac{B}{A^2}.$$

Hence,

$$A = \frac{\sqrt{(n s B)}}{\sqrt{R}} = \frac{K}{\sqrt{R}}, \quad \ldots\ldots (1)$$

and similarly,

$$A' = \frac{\sqrt{(n' s' B')}}{\sqrt{R'}} = \frac{K'}{\sqrt{R'}}. \quad \ldots\ldots (2)$$

where K and K' denote constants.

Now, let c be the current through the magnet coil, and c' that through the working coil, and let v be the velocity of any chosen

* Abstract of Paper read at the British Association.

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point of the working coil. Denoting by p the average electromotive force between the two ends of the working coil, we have—

$$p = I \frac{c}{A} \frac{1}{A'} v, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where I is a quantity depending on the forms, magnitudes, and relative positions of B and B′, and on the magnetic susceptibility of iron; diminishing as the susceptibility diminishes with increased strength of current, or with any change of R and R′ which gives increase of magnetising force.

In the single-circuit dynamo (that is, the ordinary dynamo) c' is equal to c, but not so in the shunt-dynamo. In each, the whole electric activity (that is, the rate of doing work) is $p\,c'$; or, by (3)—

$$I \frac{c\,c'}{A\,A'} v, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

or, by (1) and (2),

$$\frac{I \sqrt{(R\,R')}\, c\,c'\,v}{K\,K'}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Of this whole work, the proportions which go to waste in heating the coils and to work in the external circuit are

$$R\,c^2 + R'\,c'^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{waste} \quad . \quad . \quad (6)$$

$$\frac{I \sqrt{(R\,R')}\, c\,c'\,v}{K\,K'} - (R\,c^2 + R'\,c'^2) \quad \text{useful work} \quad (7)$$

By making v sufficiently great, the ratio (6) to (7) (waste to useful work) may be made as small as we please. Our question is, how ought R and R′ to be proportioned to make the ratio of waste to work a minimum, with any given speed? or, which comes to the same thing, to make the speed required for a given ratio of work to waste a minimum? To answer it, let r be the ratio of the whole work to the waste. We have, by (5) and (6)—

$$r = \frac{I \sqrt{(R\,R')}\, c\,c'}{R\,c^2 + R'\,c'^2} \frac{v}{KK'}. \quad . \quad . \quad . \quad . \quad . \quad (8)$$

For the single-circuit dynamo we have $c = c'$, and (8) becomes

$$r = \frac{I \sqrt{(R\,R')}}{R + R'} \frac{v}{KK'}, \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

or,

$$r = \frac{I \sqrt{\{R\,(S - R)\}} v}{S\,K\,K'}, \quad . \quad . \quad . \quad . \quad . \quad (10)$$

where

$$S = R + R' \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

Suppose now S to be given, and suppose for a moment I to be constant. The problem of making r a maximum with v given, or v a minimum with r given, requires simply that R (S − R) be a maximum; which it is when $R = \frac{1}{2} S$, that is, when the resistance in the working coil and the electro-magnet are equal. But in reality I is not constant; it diminishes with increase of the magnetising force. As it generally depends chiefly on the soft iron of the electro-magnet, and comparatively but little on the soft iron of the moving armature, or on iron magnetized by the current through the moving coils, it will generally be the case that I will, *cæteris paribus*, be diminished by increasing R and diminishing R′. Hence the maximum of r/v is shown by (10) to require R′ to be somewhat greater than $\frac{1}{2}$S; how much greater we cannot find from the formula, without knowing the law of the variation of I.

Experience and natural selection seem to have led in most of the ordinary dynamos, as now made, to the resistance in the electro-magnet being somewhat less than the resistance in the working coil, which is in accordance with the preceding theory.

Whether the useful work of the dynamo be light-giving, or power, or heating, or electro-metallurgy, we may, for simplicity, reckon it in any possible case by referring to the convenient standard case of a current through a conductor of given resistance, E, connecting the working terminals of the dynamo. This conductor, in accordance with general usage, I call the "external circuit," which is an abbreviation for the part of the whole circuit which is external to the dynamo. In the case of the single-circuit dynamo, the current in the external circle is equal to that through the working coil and electro-magnet, or c of our notation. Hence, by Ohm's law—

$$c = \frac{p}{E + R + R'}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

or, by (3), (1), and (2),

$$c = c \frac{I \sqrt{(R\,R')}\, v}{K\,K'\,(E + R + R')}. \quad . \quad . \quad . \quad . \quad (13)$$

Hence either

$$c = 0, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

or

$$I = \frac{K\,K'\,(E + R + R')}{\sqrt{(R\,R')}\, v} \quad . \quad . \quad . \quad (15)$$

The case of $c = 0$ is that in which

$$v < \frac{K\,K'\,(E + R + R')}{I_0 \sqrt{(R\,R')}}. \quad . \quad . \quad . \quad . \quad (16)$$

where I_0 denotes the value of I for $c = 0$. To understand it, remember we are supposing no residual magnetism. For any speed subject to (16), the dynamo produces no current. When this limit is exceeded the electric equilibrium in the circuit becomes unstable; an infinitesimal current started in either direction rises rapidly in strength, till it is limited by equation (15), through the diminution of I, which it produces. Thus, regarding I as a function of c, we have in (15) the equation mathematically expressing the strength of the current maintained by the dynamo when its regular action is reached. Using (15) in (10) we find—

$$r = \frac{E + S}{S}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (17)$$

which we all knew forty years ago from Joule.

In the shunt-dynamo the whole current, c', of the working coil branches into two streams, c through the electro-magnet, and $c' - c$ through the external circuit, whose strengths are inversely as the resistances of their channels. Still calling the resistance of the external circuit E, we, therefore, have—

$$c\,R = (c' - c)\,E, \text{ which gives } c = \frac{E}{R + E} c'. \quad . \quad . \quad (18)$$

Hence, by Joule's original law, the expenditure of work per unit of time in the three channels are respectively

$$\left.\begin{aligned} &R'\,c'^2 \quad . \quad . \quad . \quad . \quad \text{working coil} \\ &R\left(\frac{E}{R + E}\right)^2 c'^2 \quad . \quad \text{electro-magnet} \\ &E\left(\frac{R}{R + E}\right)^2 c'^2 \quad . \quad \text{external circuit} \end{aligned}\right\} \quad . \quad . \quad . \quad (19)$$

Hence, denoting as above by r the ratio of the whole work to the work developed in the external circuit, we have—

$$r = \frac{R' + R\left(\frac{E}{R + E}\right)^2 + E\left(\frac{R}{R + E}\right)^2}{E\left(\frac{R}{R + E}\right)^2}, \quad . \quad . \quad (20)$$

whence

$$\left.\begin{aligned} R^2 r &= R' \frac{(R + E)^2}{E} + R\,(R + E) \\ &= \frac{R'\,R^2}{E} + (R + R')\,E + R\,(2'\,R + R) \end{aligned}\right\} (21)$$

Suppose now R and R′ given, and E to be found; to make r a minimum. The solution is—

$$E = \sqrt{\frac{R'\,R^2}{R + R'}}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (22)$$

and this makes

$$r = 2 \sqrt{\frac{R'\,(R + R')}{R^2}} + \frac{2\,R' + R}{R}. \quad . \quad . \quad (23)$$

Put now

$$\frac{R'}{R} = e, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (24)$$

(22) and (23) become

$$E = \sqrt{\frac{R\,R'}{1 + e}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (25)$$

and

$$r = 1 + 2 \sqrt{\{e(1 + e)\}} + 2e. \quad . \quad . \quad . \quad . \quad (26)$$

For good economy r must be but little greater than unity; hence e must be very small, and therefore *approximately*

$$\left.\begin{aligned} &E = \sqrt{(R\,R')} \\ \text{and} \quad &r = 1 + 2\sqrt{e} \end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (25)$$

For example, suppose the resistance of the electro-magnet to be 400 times the resistance of the working coil (that is, $e = 400$), and we have, approximately,

$$E = 20\,R', \text{ and } r = 1 + \tfrac{1}{10}.$$

That is to say, the resistance in the external circuit is 20 times the resistance of the working coil, and the useful work in the external circuit is approximately $\frac{10}{11}$ of that lost in heating the wire in the dynamo.

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THE ELECTRICIAN.

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TELEGRAPHY IN WARFARE.

Once upon a time a beleagured garrison manned its battlements with dummy warriors, who were only annihilated when all the ammunition of the besiegers was exhausted. What followed it is needless to recount. We do not believe a word of it, any more than we believe in the Trojan horse. Finesse of this kind is the property of higher civilisation; and coming to us from a barbarous age such stories are the invention of the inspired poet rather than the incidents of actual warfare. It is only the modern soldier who knows how to deny himself and profit by his enemy's excess of zeal. Formerly it was the fashion to encircle the foe sitting by his camp fire and straightway slaughter him. Nowadays, if we slaughter him at all, we take care first to listen to what he is talking about. Arabs, and Zulus, and Fenians may continue the merely destructive habit of breaking down the telegraph; but it is reserved for more intelligent peoples to *tap the wires*. This is, perhaps, as clever as cleverness could be, and has no parallel in ancient lore, except, perhaps, the liberation of a captured rat, duly tarred and feathered, to be a warning to his brethren. To "tap the wires" is not exactly a new idea; it was done more than once during the Franco-Prussian war, but the practice has only recently developed into an art. We read the other day, with feelings that would have been of pride if they had not been tempered with dismay, that the German war authorities had organised a body of military telegraphists with the express object of tapping the enemy's wires. This is truly appalling, for at first sight it seems to render all telegraphic communication for the purposes of war utterly futile and even mischievous. A little reflection, however, may reassure us, and show that, on the whole, this move on the part of the forwardest of military nations only proves the necessity for making telegraphic instruction more general, and, among soldiers, more efficient than at present.

To tap a telegraph wire is a very simple process, and, when skilfully done, does not betray itself to the most watchful of correspondents. The invention of the telephone has simplified matters since the war between France and Germany, at all events on Morse circuits. With an enemy inside your borders no ordinary telegram is certain to reach its destination with its secret unrevealed. The moral effect of this uncertainty is, obviously, very serious; and, indeed, it is probable that to partially paralyse the national telegraph system through sheer apprehension of using it for the benefit of an invading army is one main object of publicly announcing the formation of a "tapping corps." Tapping is a trick which can only be played when one of the parties is unsophisticated. But the knowledge that it can be played has pretty much the same effect as the playing of it. If the eavesdropper gets no information himself he prevents other people getting it, which is the next best thing for him. Code messages would not get over the difficulty. Between generals in the field communication in cypher might often be highly inconvenient; and were it not so the tapper would promptly resort to cutting. But with a highly intelligent and well instructed corps of military telegraphists it would certainly be possible to reduce these dangers to a minimum. No nation is likely to abandon its telegraphs altogether as an instrument of communication in warfare because of its liability to be tapped, and the problem for the military authorities is how best to lay down their system, and so to work it that interruption shall be difficult and tapping harmless.

As regards the first of these requirements an underground system such as that established in Germany is excellent so far as it goes, especially when, as no doubt is the case, the routes of the purely military lines are kept secret. But for field telegraphy, or for the operations of a moving army, the case is different. Here generalship will go for much, but skilled telegraphy for even more. Prearrangement between good signallers would have all the advantages of code without any of its drawbacks. A part of the future military telegraphist's training should be the working of lines possibly in the hands of an enemy. After all, it would be no difficult matter to bite the biter when the signallers have been trained to the business; but it is indispensable that they should be so trained, and we always assume that in time of war the telegraph is given over to the soldier.

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The wisdom of the steps taken by the War Office in this country some years ago has been shown in several recent campaigns. The Royal Engineers almost to a man, and a not inconsiderable number, we believe, of Royal Artillery, have been taught telegraphy. Many of them have become thoroughly skilful operators through being allowed to work as clerks in the Postal Telegraph Offices. Perhaps the one blot in this otherwise admirable arrangement is that all alike are not equally well practised, a fact which was commented upon when the last discussion took place at the Society of Telegraph Engineers on the campaigns in Afghanistan. One unskilful or ill-instructed soldier might cause the destruction of an army; and in any case the uncertainty attaching to the employment of incompetent manipulators would deprive the telegraph of much of the reliance that might otherwise be placed upon it. The superiority of skilled operators over novices has been made manifest on more than one occasion recently in time of peace for military signalling. Some volunteers, who happened also to be telegraphists, utterly astounded an assembly of professional soldiers not long ago by the rapidity of their semaphore and flag signalling; and only the other day a body of telegraph volunteers beat the regulars hollow in a mode of signalling at which the latter ought to have been peculiarly expert, the fact being that to the experienced telegraphist the Morse code is a second native language, which he can speak anyhow and interpret as you please. If ever their services are needed the telegraphic volunteers will prove a valuable adjunct to the military telegraphs of this country.

In the main we think that to render tapping powerless, or to do a little of it on our own account, reliance should be placed upon highly skilful men; but we by no means despair of electrical science doing something to circumvent the enemy. The ingenuity that makes mischief possible can usually devise something to undo it. We are glad to notice that not merely the rank and file, but the officers of the scientific regiments, are giving their serious attention to electrical matters, not without some useful results already. This is as it should be, and it would not surprise us to hear that a modern English officer had invented a code that could not be deciphered by the stranger, or devised an instrument whose signals could not be surreptitiously inspected. When civilisation is at its highest its tendency is decidedly levelling; and if one half of it is clever enough to set up dummy soldiers, the other half quickly learns to fire blank cartridges. For those whom it may concern, therefore, the new German telegraph corps will have only a momentary terror. At the Paris Electrical Exhibition there is a fine display of military telegraph trains from most European countries, and also from America. These are fully equipped for the purposes of war, and afford excellent material for studying the respective merits and demerits of the systems now commonly in use.

A New Voltaic Accumulator.—In order to obtain as large a surface for oxidation with as little volume as possible in a Planté accumulator, M. de Méritens uses corrugated lead electrodes, of such a form that when placed vertically, they leave trough-like spaces, arranged like a window blind one below another, and filled with sheets of lead paper, placed like the leaves of a book. The whole is heavily compressed, and the edges of these many sheets are uniformly soldered, so as to make a frame round the whole. Each of these plates is placed in a little square jar, as in the Faure and Planté batteries, and according to the author they will accumulate more electricity for a given quantity of lead than these batteries.—*La Lumière Electrique.*

CORRESPONDENCE.

THE CONTACT THEORY OF THE VOLTAIC CELL.—MR. FAHIE'S EXPERIMENT.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I observe that Mr. Fahie's letter, p. 249, in your issue of the 3rd ult. has not yet been answered. The experimenter appears to have been misled by an effect due to "polarisation." This may be evidenced by reversing the order of the two experiments.

Experimenting with a reflecting galvanometer, of which the resistance is about 20 ohms, adjusted to give an indication of 50 div. for microweber current, I obtained the following results:—

1. On immersing in dilute sulphuric acid one of two copper wires attached to the galvanometer terminals, grasping the other of these wires with one hand, and dipping into the acid a zinc wire held in the other hand (both hands being moistened with the acid) a deflection of about 100 divisions occurred in the direction indicating that the current flowed to galvanometer from the copper wire held in the hand. Almost immediately, however, the deflection became 50 div. on the other side of zero, rapidly falling to 10 div., and tending to zero. A deflection in the original direction occurred whenever the hand was brought into contact with a fresh surface of zinc; whilst the slight temporary current was in the reverse direction (from galv. terminal to hand holding copper) when the hand was shifted upon the copper wire. No permanent current, nor even a decided temporary current in one particular direction was observed.

2. A zinc and a copper wire being respectively attached to the galvanometer terminals, the free extremities of these wires were held, one in each hand, the hands being, as before, wetted with the dilute acid. The deflection—of course indicating a current from copper wire to galvanometer—being beyond the limits of the scale, the instrument was shunted through 1·19 ohm; the deflection then being 350 divisions, and the current (122 microwebers per sec.) being in this case permanent and tolerably constant.

These results are obviously contradictory to the conclusion arrived at by Mr. Fahie, and stated in the third paragraph of his letter. But if the copper wire employed as an electrode in the experiment which is here placed second in order be again used as an electrode in the previous experiment a temporary current will undoubtedly become evidenced, the direction of such current being from galvanometer to the "*polarised*" copper electrode.

The categorical answer to Mr. Fahie's question is that the current supposed to occur without contact of dissimilar metals is in reality due to the contact between the metals hydrogen and copper, resulting from an electro-deposition of the former upon the latter in the experiment first described in Mr. Fahie's letter.—Yours, &c.,

Desmond G. FitzGerald.

THE FAURE BATTERY.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: With reference to Mr. Willoughby Smith's letter in your last issue, I beg to testify that a battery constructed according to that gentleman's plan will give the bad results that he says he has obtained, but this battery, although falling within the specification of the "Faure" battery, is not in any way like anything yet published that I am aware of. If Mr. Willoughby Smith will call at 446, Strand, or at the Paris Exhibition, he will obtain every information on the subject, and also have the means of ascertaining for himself what the Faure battery really is.

The cell exhibited in the Strand is a box containing eleven sheets of lead, 12in. by 10in., weighing altogether 17lb., and covered with about 25lb. of red lead. The total weight of each box, including case, felt, water, lead, and oxide, is 50lb.

The resistance of each cell is about one hundredth part of an ohm, or even less than this. Twenty-eight cells will work

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a number of Swan's lamps. The electromotive force is over two volts after standing five hours, and the charging current should never have a higher electromotive force than 2·35 per cell, charged in series, instead of 50 volts, as mentioned in Mr. Willoughby Smith's letter.

I do not know what is meant by the "work done in minutes," and cannot, therefore, use the same *unit*, but I may say that one such cell as I have described above will give a current equal to 4,000 foot pounds per minute for two hours and a half, or a total of 600,000 foot pounds. The time occupied in charging may be eight hours, at a rate of 16 webers per second; thus, consequently, the comparison made by Mr. Willoughby Smith with a Leclanché cell is very much out of the way. Again, the cost of one horse-power for one hour by the intermediary of the secondary battery need not be over a fraction of a penny, whereas if ordinary batteries were used the cost would amount to a few shillings.—Yours, &c., W. LACHLAN.

THE POETRY OF INCANDESCENT LIGHTING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In turning over some old American MSS. and papers, I have come upon what appears to be the original draft of Longfellow's well-known poem "Caspar Becarra." Perhaps it will interest your readers.—Yours, &c., 772, 32·2.

CASPAR BECARRA EDISON.

By his evening fire, the inventor
Pondered o'er his secret shame,
Baffled, weary, and disheartened,
Still he mused and dreamed of fame.

Electric incandescent lighting
Long had taxed his utmost skill;
But as yet the fair ideal
Vanished and escaped him still.

From the distant Ural mountains
Was the precious metal brought,
Day and night the anxious master,
At his toil untiring wrought.

Till discouraged and desponding
Sat he now in shadows deep,
And the day's humiliation
Found oblivion in sleep.

Then a voice cried "Rise, Oh Master!
From the burning cane and oak;
Shape the thought that stirs within thee!"
Startled, the inventor woke.

Woke, and from the smoking embers
Seized the charred and glowing wood,
And therefrom he made his filament,
Saw that it was very good.

Be thou artist or inventor,
Take this lesson to thy heart:
That is best that lieth nearest,
Shape from that thy work of art.

MAGNETIC BELLS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I beg to state that magnetic bells similar to those of Messrs. Siemens, described in your issue of the 17th instant, but having only three magnets instead of six, are now very extensively used in telephone exchanges, both in this country and in America, and that they are fast replacing the battery system. Whilst the first cost for short lines is only about 25 per cent. to 30 per cent. more than the equivalent cell power, for long lines it is absolutely much less, as eight or 10 cells are then necessary to ring; and as the magnetic bells require neither maintenance nor renewal their economy is manifest. In the United States they have been used for distances up to 400 miles, and found to work efficiently.

Yours, &c., MAGNETO.

M. TISSANDIER'S APPLICATION OF ELECTRIC MOTORS TO THE PROPULSION OF BALLOONS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Reading in the last number of your paper a discussion of the above, I beg to suggest an improvement of the same. As in a balloon it is not possible to ascend and descend more than a very few times, both gas and ballast soon being exhausted, the following seems to us the only way of overcoming the difficulty—viz., to construct underneath the elongated balloon another of the same shape, but rather larger, which would be connected by a flexible tube, with a pair of bellows in the car, the lower balloon remaining folded up till wanted. The aeronaut to descend would only have to inflate the lower balloon by means of the bellows with common air, which would render the balloon steady enough to descend. To reascend he would allow the air to escape. This might be repeated any number of times. The metal tube of the bellows should be surrounded by a freezing mixture to render the air as cold as possible.—Yours, &c.,

F. DE WOLFFERS.

OBSERVATIONS OF ATMOSPHERIC ELECTRICITY AT KEW OBSERVATORY DURING 1880.*

BY G. M. WHIPPLE.

The author having spoken of the work already done, stated that he had devised a modification of Professor Everett's method, and had constructed a glass scale by means of which curves could be tabulated with great facility. They had commenced tabulating and discussing the accumulated records, and he was able to state some of the facts derived from the curves for 1880. Having determined the atmospheric tension for every hour during the year when measurement of the trace was possible, the diurnal, monthly, and annual variations were computed. The months of maximum tension were January and March, and of minimum tension August and September. From the year's observations it was found that the laws vary in summer and winter; for the summer months the tension was greatest with an east wind and lowest with a north wind, whilst in winter the tension was greatest with north and north-west winds and least with south-east winds. From the results obtained it was found that light winds had a higher potential than strong winds. This, however, was not well marked in summer, but is almost entirely confined to winter observations.

THE ILLUMINATING POWERS OF INCANDESCENT VACUUM LAMPS WITH MEASURED POTENTIALS AND MEASURED CURRENTS.*

BY SIR WILLIAM THOMSON AND JAMES T. BOTTOMLEY.

The electromotive force used in these experiments was derived from Faure secondary batteries, kindly supplied for the purpose by the Société la Force et la Lumière in their London office.

Two galvanometers were used simultaneously, one called the *potential galvanometer* for measuring the difference of potentials between the two terminals of the lamp, the other (called the current galvanometer), for measuring the whole strength of the current through the lamp.

The potential galvanometer had for its coil several thousand metres of No. 50 (B.W.G.) silk-covered wire (of which the copper weighs about $\frac{1}{25}$ gramme per metre, and, therefore, has resistance of about 3 ohms per metre). Its electrodes were applied direct on the platinum terminals of the lamp.

The current galvanometer had for its coil a single circle of about 10 centimetres diameter of thick wire placed in the direct circuit of the lamp, by means of electrodes kept close together to a sufficient distance from the galvanometer to ensure no sensible action on the needle except from the circle itself. The directive force on the needle which was produced by a large semi-circular horseshoe magnet of small sectional area was about $2\frac{1}{2}$ c.g.s., or 15 times the earth's horizontal magnetic force in London. This arrangement would have been better for the potential galvanometer also than the plan actually used for it, which need not be described here. The scale of each galvanometer was

* Abstract of a paper read before the British Association.

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graduated according to the natural tangent of the angle of deflection, so that the strength of the current was simply proportional to the number read on the scale in each case.

Three lamps were used, Nos. II. and III. of a larger size than No. I. The experiment was continued with higher and higher potentials on each lamp till its carbon broke.

The illuminating power was measured in the simplest and easiest way (which is also the most accurate and trustworthy), by letting the standard light and the lamp to be measured shed their lights nearly in the same direction on a white ground (a piece of white paper was used), and comparing the shadows of a suitable object (a pencil was used), and varying the distance of the standard light from the white ground till the illuminations of the two shadows were judged equal. The standard used was a regulation "standard candle," burning 120 grains of wax in the hour. The burning was not actually tested by weighing, but it was no doubt very nearly right, nearly enough for our purpose, which was an approximate determination of the illuminating powers of each lamp through a wide range of electric power applied to it. The following results were obtained :—

LAMP No. I.

No. of Experiment.	Cells.	Volts.	Webers.	Volts × webers ÷ 10 ≒ kilogrammetres.	Horse-power.	Candles.	Candles per horse-power.
1	26	56·9	12·1	6·88	·093	11·6	125
2	30	65·5	14·6	9·56	·129	25	194
3	32	70·2	16·4	11·51	·156	42	263
4	33	71·8	17·4	12·48	·170	38	224
5	34	74·1	18·1	13·42	·181	44	243
6	35	76·1	18·2	13·86	·187	55	294
7	36	78·0	19·9	15·52	·210	63	300
8	37	80·3	20·6	16·54	·224	66	295
9	38	81·9	20·6	16·88	·228	76	333
10	39	84·6	20·6	17·43	·235	82	349
11	40	87·0	21·0	18·27	·247	84	340
12	42	90·9	21·7	19·72	·267	102	382
13	44	92·0	21·7	19·96	·270	89	330
14	46	99·1	22·1	21·91	·296	114	385

Carbon of lamp broke with same power, immediately after the measurement of the light was completed.

LAMP No. II.

No. of Experiment.	Cells.	Volts.	Webers.	Volts × webers ÷ 10 ≒ kilogrammetres.	Horse-power.	Candles.	Candles per horse-power.
1	40	89·7	22·07	19·8	·27	49	181
2	42	93·3	22·96	21·42	·29	68	234
3	43	95·4	23·8	22·71	·31	76	245
4	44	98·8	24·9	24·60	·33	101	306
5	46	103·0	26·3	27·09	·37	117	316
6	50	106·9	27·4	29·29	·40	147	367
7	52	110·8	28·5	31·56	·43	189	440
8	54	117·0	29·5	34·53	·47	196	417
9	56	119·8	29·5	35·34	·47	186	388
10	58	121·8	29·8	36·29	·49	177	361
11	40	87·0	21·4	18·62	·25	35	140
12	42	89·7	22·4	20·09	·27	42	156
13	60	122·8	30·6	37·58	·51	186	365
14	62	126·0	31·3	39·44	·53	180	340
15	66	132·4	32·4	42·89	·57	222	383
	70	Carbon of lamp broke.					

LAMP No. III.

No. of Experiment.	Cells.	Volts.	Webers.	Volts × webers ÷ 10 ≒ kilogrammetres.	Horse-power.	Candles.	Candles per horse-power.
1	40	82·3	28·5	23·45	·31	68	219
2	50	101·8	39·0	39·70	·54	195	361
3	60	Carbon of lamp broke.					

Some of the irregularities of the results in the preceding tables are very interesting and important, as showing the effect of the blackening of the glass by volatilisation of the carbon when too high electric power came to be applied.

The durability of the lamp at any particular power must be tested by months' experience before the proper intensity for economy can be determined.

ON MAGNETIC DISTURBANCES.*

BY PROF. W. G. ADAMS, F.R.S.

The author, in considering magnetic disturbances, stated that certain facts about them had long been known; from the observations of Gauss in 1834 the disturbing power was found to increase in northern latitudes; it was also found that the appearance of a disturbance occurred in several places at the same instant, but with great differences of results. The force seemed to originate at a certain point in the interior of the earth, and the direction of the disturbing force seemed constant, yet great differences were observable at places not remote from one another. Sabine found that these disturbances had daily and yearly variations from their mean values, and that they have an eleven-year period corresponding to the appearance of spots upon the sun. It has been shown by observations that magnetic disturbances and electric currents on the earth are related; these electric currents in the earth have commonly been attributed to changes of temperature.

The month of March, 1879, was chosen for a comparison of the photographic records of magnetic disturbances, and records for the whole month were sent from Lisbon, Coimbra, Stonyhurst, Vienna, St. Petersburg, and Bombay in the northern hemisphere, and from Melbourne and the Mauritius in the southern hemisphere. Taking the disturbances on March 15-16, 1879, as an instance, we see that soon after 10 a.m. Greenwich time on the 15th, a disturbance-wave happens, which shows first a diminution and then an increase of horizontal force at St. Petersburg, Vienna, Kew, and Lisbon, and also at Melbourne in Australia. At 9:30 p.m. of the same day a magnetic storm begins, and continues for about an hour. It is felt in the northern and southern hemispheres. At all stations in Europe the horizontal force is increased in the first part of the storm, and then diminished. At Lisbon the vertical force is first increased and then diminished, and at St. Petersburg and Stonyhurst there is a diminution in the vertical force at the same time as at Lisbon.

Regarding the declination needles, we find that at St. Petersburg, Melbourne, and Bombay the declination westward is first increased and then diminished, whereas at Kew and Lisbon the motions are in opposite directions. At Bombay and Mauritius, near to, but on opposite sides of, the equator, the declination needles are deflected opposite ways. If we assume that by magnetic induction the earth's magnetism is altered, the position of the magnet which would cause the disturbance must be such that its pole, which attracts the marked end of our needle, must lie at the beginning of the disturbance to the east of Kew and Lisbon, to the north of Vienna, and to the north-west of St. Petersburg; the Lisbon vertical force curve also shows it to be below the surface of the earth. Hence an inductive action equivalent to a change of position of the north magnetic pole towards the geographical pole would account for these changes.

The strengthening and weakening of a magnet with its north pole to the north on the meridian of Vienna might account for magnetic changes observed between 9:30 and 10:30 at night, Greenwich time, on March 15, 1879. In attempting to explain this disturbance by currents of electricity or discharges of statical electricity in the air above the needles, we must imagine that at first there is a strong current from the south-west over St. Petersburg, from the west over Vienna, and from the north-west over Kew and Lisbon, the vertical force needle at Lisbon showing that the current from the north-west lies somewhat to the east of Lisbon; that at the Mauritius this current is from the north, and at Bombay from the south. Thus we must imagine that a current of electricity passes down from the north west to the south-east, going on towards the east over Vienna, and towards the north-east over St. Petersburg. This must be kept up very much along the same line throughout the first part of the disturbance, and then the current must be altered in strength in the same manner at all stations.

An examination of the principal disturbances at Kew and at St. Petersburg seems to show that (1) a diminution in the horizontal force is accompanied by greater easterly deflections of the declination needle at St. Petersburg than at Kew; (2) increase of horizontal force is accompanied by greater westerly deflections at St. Petersburg than at Kew, or is sometimes accompanied by a westerly deflection at St. Petersburg and an easterly deflection at Kew. Only moderate disturbances have already been considered, and the author now treats of a much larger magnetic storm which began at 10:20 a.m. Greenwich time on August 11. This storm may be divided into three storms—one lasting from 10:20 on the 11th to 1 a.m. on the 12th; a second from 11:30 a.m. on the 12th to 7:20 a.m. on the 13th; and the third from 11:50 a.m. on the 13th to 7 to 8 a.m. on the 14th of August.

* Abstract of paper read before the Brit. Asso., York meeting, 1881.

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The first storm began on August 11, at the same instant at all stations. There is a decided similarity, especially in the horizontal force curves, throughout the first part of this storm, and certain points in it stand out prominently. The deflections are alike at Lisbon, Kew, Vienna, St. Petersburg, and after the first very sudden deflection at Toronto also. The greatest effect is produced at St. Petersburg; the similarity between the large disturbances at Vienna and Toronto, in Canada, places differing about six and a half hours in time, is remarkable. About 11:45 p.m. and 2:40 p.m. there are very remarkable points of agreement. From about 4:30 p.m. to 8 p.m. Greenwich time, *i.e.*, from about 11 a.m. to 2:30 p.m., Toronto time, the deflections are opposed at Toronto and at Vienna or Kew. This would point rather to solar action as the cause of the disturbance. At 9 p.m. the disturbances are all in the same direction. but about 11 p.m., whilst St. Petersburg agrees in direction with the others in a very violent phase of the storm, at Toronto the direction of the deflections is reversed, and this reversal of curves continues until about the end of the first of the three storms.

The second storm, the most remarkable of the three, began about 11:30 a.m. on the 12th, and lasted until the next morning. At Toronto the line goes off the edge of the paper on which the photographic record is taken. At Vienna and Melbourne the motion is so rapid that the plate is not sensitive enough to receive the impressions. At 12:20 midday, the time of greatest disturbance at Lisbon and at Zi-ka-Wei near Shanghai in China, two places nine hours different and nearly in the same latitude, the vertical force is increased in precisely the same fashion. At St. Petersburg the change in the horizontal force was one thirty-fifth part of the whole horizontal force, and the total force was changed to about one-eightieth part of its full value. These magnetic changes are so large as to be quite comparable, as we see, with the earth's total force, so that any cause which is shown to be incompetent from the nature of things to produce the one can hardly be held to account for the other.

CANTOR LECTURES.*

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

BY PROFESSOR W. GRYLLS ADAMS, F.R.S.

(CONTINUED FROM PAGE 299.)

LECTURE III.—DELIVERED MONDAY, MARCH 21, 1881.

Use of magneto and dynamo-electric machines for electric lighting. Electric lighting by means of the arc.

The fundamental principles which underlie all magneto-electric machines are the four great principles discovered by Oersted, in 1819, by Ampère and Arago, in 1820, and by Faraday, in 1831. In 1819 Oersted discovered the action of a current of electricity on a magnet. In 1820 Ampère discovered the action of magnets and currents on currents of electricity in their neighbourhood, and in the same year Arago showed that currents of electricity produced magnetisation, thus laying the foundations of electro-magnetism; and in 1831 Faraday showed that induced currents were produced by the motion of magnets. All machines for the conversion of work into electricity are founded on Faraday's great discovery of the induced current, derived from the relative motion of a magnet and a coil of wire.

Magneto-electric machines are divided into two great classes, according as they furnish continuous currents or alternate currents. All such machines are alternate, as far as regards the currents in the coil; but these currents are made to flow always in the same direction in the external circuit, in continuous current machines, by means of a commutator which reverses the contact at every half-turn.

The machines of Pixii, in 1832, followed by those of Saxton and Clarke, were the first continuous current machines. From these we may pass to Wheatstone's introduction, in 1845, of electro-magnets in place of permanent magnets, to produce the magnetic field. In 1854 Messrs. Werner, Siemens, and Halske introduced the Siemens armature, in which the coil is wound longitudinally in a groove. The strength of the continuous current depends on the velocity of rotation, on the length of the wire, and on the power of the magnetic field formed by the magnets.

* Reprinted from the *Journal* of the Society of Arts for August, 1881.

It is remarkable that, in 1854, Hjorth originated an idea which was some thirteen years in advance of his time; he patented an improved magneto-electric battery, in which the currents induced in the revolving armature pass round the electro-magnets, and increase their magnetism, and so increase the induced currents at compound interest rate. This was the celebrated principle afterwards re-discovered by Siemens and by Wheatstone simultaneously in 1867, which has formed the basis of all dynamo-electric machines, and which, for equal power are cheaper and more compact than all other magneto-electric machines.

DYNAMO-ELECTRIC MACHINES.

In February, 1867, Dr. Siemens and Sir Charles Wheatstone, on the same evening, presented to the Royal Society their two papers "On the Augmentation of the Power of a Magnet by the Reaction Thereon of Currents Induced by the Magnet Itself." According to the principle then put forward by Dr. Siemens, the rotating armature, the electro-magnet, and the external resistance, such as an electric lamp, are joined up so as to form one simple circuit. A small amount of magnetism is communicated to the electro-magnet, so that, on rotating the coil, a current is induced alternately in opposite directions, and after being reduced to the same direction by a commutator, this current passes through the coils of the electro-magnet in such a direction as to make it stronger, so enabling it to react on the armature. Thus the magnet and the armature act and react on one another, strengthening the magnetic field, and continually strengthening the induced currents. Sir Charles Wheatstone put forward the same principle, and called attention to the fact that at the first instant of completing the combined circuit the effects are stronger than they are permanently. The principle of these

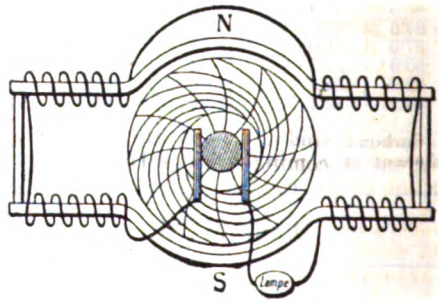

FIG. 1.—DYNAMO-ELECTRIC MACHINE.

dynamo-electric machines is clearly shown in Fig. 1, where N and S represent the poles of the electro-magnet enclosing the revolving armature, the external resistance in the circuit being represented by an electric lamp. Sir Charles Wheatstone also pointed out that a very remarkable increase of all the effects is observed, when a shunt is employed to divert a great portion of the current from the electro-magnet. By that means four inches of platinum wire, ·0067 inch diameter, was made to glow. A certain resistance in the shunt was found to be necessary to produce the best effects, so as neither to weaken the magnetism too much, nor to give the current too much work to do in heating a high resistance.

In addition to this, Sir Charles Wheatstone showed that the effects above described are far inferior to the effects obtained by placing the work to be done in the shunt circuit. Thus seven inches of wire were made to glow in the shunt, when only four inches of the same wire would glow in the original circuit. There is thus a double advantage, for there is no loss of resistance by introducing the shunt, the resistance of the shunt being the resistance on which the useful work is done.

This improvement, suggested by Sir Charles Wheatstone in 1854, and now being adopted by Dr. C. W. Siemens in his latest dynamo-electric machines, is very well shown in Fig. 2, for which, as well as for the other figures illustrating this lecture, I am indebted to the kindness of the Director of *La Lumière Electrique*.

Wheatstone also showed that the effects are much less influenced by a resistance in the electro-magnet branch than in either of the other branches. Thus, with about four inches of glowing platinum wire in circuit, the addition of about five inches of platinum wire in the armature branch, or in the shunt, produced a ¾-inch glow, whilst four feet of the same wire was required in the electro-magnet branch to reduce the glow to three-fourths of an inch. Dr. Siemens has shown that, for the greatest efficiency, the resistance of the rotating coil must be small, but the resist-

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ance of the electro-magnet may be increased, and that in both

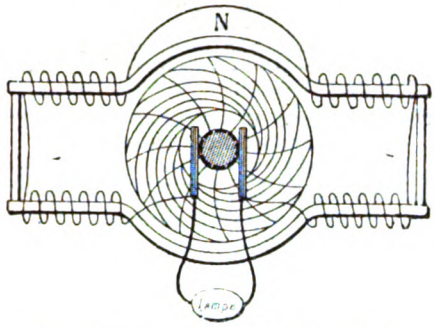

FIG. 2.—DYNAMO-ELECTRIC MACHINE.

cases the wires should not be small, but of considerable diameter.

THE GRAMME RING.

In the Gramme armature, coils of wire are wound in sections, all in the same direction, round a ring; and each section, when a current is flowing through it, may be regarded as an electro-magnet. The similar poles of all these sectional electro-magnets will point in the same direction round the ring. Consider only one of these electro-magnets with its north pole directed towards the south pole of another magnet, it will be attracted towards it, and with greater and greater force the nearer it approaches; on passing the south pole, its own south pole will be presented to the south pole of the fixed magnet which it has just passed, and its motion will be continued in the same direction.

Now, suppose no current to be flowing in the ring, then, on applying force to produce the same motion as before, the induced current will be in the opposite direction, *i.e.*, as the coil revolves towards the south pole and past it, the induced current in the coil is round the ring, as we look at it from behind, in the direction opposite to the motion of the hands of a watch.

With right-handed winding of the wire on the ring like a corkscrew, the current is coming towards the observer, or in the opposite direction to the motion of the ring on the side nearest the south pole.

If we consider a section of the ring as it approaches and goes away from the north pole of the magnet, the induced current in the coil, as the observer looks at it from behind, will be in the same direction as the hands of a watch move, so that the current will be away from the obsesver, or in the same direction as the motion of the ring on the side nearest the north pole. Hence, currents flow opposite ways round the ring in the two halves of the ring, and meet at points equidistant from the two poles.

DYNAMO-ELECTRIC MACHINES.

When the armature of a dynamo-machine is turned, the amount of work which is produced by means of it is proportional to the number of turns of the armature per minute. If the same current passes through the electro-magnet and the armature, then the current in one acting on the current in the other will attract or repel it with a force proportional to the product of two currents, *i.e.*, to the square of the current. The action between the currents is increased four-fold, when the current in each is doubled. Hence, when such a machine is used as a generator of an electric current, the external work which can be done by that current in the electric arc or elsewhere is proportional to the square of the current.

USE OF SEPARATE EXCITING MACHINE.

In all dynamo-electric machines, where the same current passes round the magnet and the armature, any disturbance in the resistance of the outer circuit, in the electric arc for instance, at once alters the current, and this alters the strength of the magnetic field, which again produces a further disturbance in the current, so that any disturbance is intensified, just as the permanent magnetism of the iron core is intensified by the action of the current in the machine on itself.

To obtain greater regularity, Wilde, in 1863, proposed to employ a separate continuous current machine to give a permanent magnetic field, and to revolve the armature of the second machine between the poles of the magnet which is excited by the first machine. In order to find the yield or effective work of these machines, and their efficiency for electric lighting or for other purposes, we have seen, from the laws of Ohm and Joule, that measurements of current, and of the work done by the current, must be made.

In the last lecture I indicated four methods of making such measurements, viz.:—

1. The galvanometer method.
2. The heat method, *i.e.*, by the change of temperature produced by the current in a wire of given resistance.
3. The electrometer or potentiometer method.
4. The electro-dynamometer method, *i.e.*, by the attraction between different parts of the same current.

EFFICIENCY OF MAGNETIC & MAGNETO-ELECTRIC MACHINES.

If we take a battery in a closed circuit, we know, from the laws of Faraday, that the amount of current produced is directly proportional to the weights of the chemical elements decomposed in each of the cells of the battery, the quantity of zinc dissolved in the battery being a measure of the quantity of current which has passed. According to the laws of transformation of energy, the work done in the chemical actions is here equivalent to the work done in heating the circuit. We may express the energy or the work done by electric currents in the same way as we express the energy of a head of water by the pressure multiplied by quantity of water. The electromotive force corresponds to pressure, and the current flowing to the quantity of water, so that the work done by the current is the product of electromotive force by the quantity of electricity.

The work which can be done in the circuit is $E_0 C_0$, where E_0 is the electromotive force of the battery, and this is spent in heating the resistance. Hence, $E_0 C_0 = C_0^2 R$, where C_0 is the current produced through the resistance R. Now, if any portion of the circuit, carrying a current, be set in motion, under the action of exterior magnetic forces, or under the influence of the mutual reactions of the currents in the fixed and movable parts, then the equivalent to the chemical actions in the battery will be spent in producing the heating of the conductor, and partly in doing the work of the electro-dynamic or magnetic forces. Representing the work done in producing motion by K, and the current in this case by C, we get $E_0 C = C^2 R + K$. The work K is equivalent to the external work done by the current C. Now this external work K gives rise to an opposing electromotive force in the induced circuit, and the energy of this induced current is $EC = K$; or $E = \frac{K}{C}$ is the electromotive force due to induction.

The efficiency of an induction machine, when used as a motor, is the ratio of the work K to the total work $K + C^2 R$, *i.e.*, the ratio of the electro-motive force of induction to the total electromotive force of the battery. The efficiency

$$\rho = \frac{E}{E_0} = \frac{K}{K + C^2 R} = \frac{1}{1 + \frac{C^2 R}{K}}.$$

The effective work $K = EC$ and $CR = E_0 - E$. Therefore $K = \frac{E(E_0 - E)}{R}$.

If, then, a battery of electromotive force E_0 be employed, and an induction machine be employed as a motor, then the effective work depends upon the product of two quantities, one of which increases as fast as the other diminishes.

Now, if one quantity increases as fast as another diminishes, their product is greatest when the two are equal. Hence such a machine is most effective when $E = E_0 - E$, *i.e.*, when $E = \frac{1}{2} E_0$, so that $K = C^2 R$ and $\rho = \frac{1}{2}$.

Half the work of the battery is then spent in heating the circuit, and the other half in doing the external work. This corresponds to the case where the strength of the battery current is diminished by one-half through the effects of induction. If the same machine be employed to produce a current of electricity by applying external work to it to turn it, then the energy of the induced current is equal to the work done by the currents during the motion, or $K = EC$. If K is greater than EC at first, then the machine will go faster and faster, and E and C will increase, until the product becomes equal to K, when the motion will remain steady. Hence such a machine should give induction currents of the greatest efficiency when used as a motor.

The above conclusions have been arrived at by considering the attractive and repulsive forces between different parts of a battery current, where the electromotive force of the battery does not change.

(TO BE CONTINUED.)

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A NEW FORM OF LIGHTNING CONDUCTOR.*

BY SAMUEL VYLE, A.S.T.E.

The paper referred to the damage caused by recent thunderstorms, and pointed out that experience and the opinion of scientific authorities went to show that a lightning conductor of sufficient capacity, when properly fixed, and having good contact with the earth, was a certain protection against lightning. The radius protected by each conductor was still a matter of controversy, but it appeared that a conic section equal to its height was within the bounds of safety.

Referring to the repeated utterances of scientists as to the absolute necessity of testing lightning conductors in order to know their condition, the author indicated the difficulties that existed in getting these tests made, which were both costly and dangerous, a wire from the ground to the top of the conductor being necessary before the electrician could commence; on lofty places and high spires this was impracticable. Recognising this difficulty, last year Mr. Vyle was led to the invention of the new form of conductor which he exhibited. It was, in fact, a copper cable, with an insulated wire set within the core, which being metallically connected to the conductor at the top, offered a ready means of testing it whenever desirable, the lower end of the inner wire being always within reach.

Having then this testing wire, it became necessary to provide the means of measuring its resistance, and this has been done by a differential galvanometer, fitted with three keys A, B, C. The depression of A and B separately sends currents up the testing wire to the top of the conductor, down which it passes to the earth, and also through an artificial circuit or resistance exactly equal to that of the wire and cable referred to. The indicating needle is deflected to the side of the key depressed. If, however, both A and B are pressed down at the same time the needle will remain stationary or balanced, thereby proving the conductor good. In case the needle is deflected key C is brought into use, and being depressed at the same time as A proves whether the conductor is good or the fault is to be looked for above ground. Mr. Vyle applied this apparatus whilst at York to the testing of the conductors on York Minster, assisted by Mr. W. H. Preece, F.R.S.

Permission having been obtained from the Dean, two men ascended to the central tower of the minster, and from thence threw down a small ball of string, which being caught below had a stronger one attached, and in its turn had tied to it an insulated wire, which on being drawn up enabled conversation to be carried on by means of the telephone, to arrange details and save shouting. The top of the conductor having been filed clean, the wire was connected thereto, and the test made from below, by means of Mr. Vyle's apparatus, and also by a Wheatstone Bridge.

* Abstract of paper taken as read, Section G, British Association, York meeting, 1881.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Sept. 28.		Business Done Week Ending Sept. 28. Highest.		Lowest.	
Anglo-American	53⅛,	54	54		51⅞	
Do. Deferred	83⅛,	4⅛	84⅛		82⅛	
Do. Preferred	24⅛,	25	24⅛		24	
Brazil Submarine	10⅞,	11	11		10⅛	
Cuba	9⅛,	10	9⅞		9⅛	
Do. Preference	16⅛,	17	—		—	
Direct Spanish	5,	¼	5⅛		5⅛	
Do. Preference	14⅛,	5⅛	15		15	
Direct United States Cable	10⅛,	⅞	10⅛		10⅛	
Eastern Telegraph	10⅛,	⅛	10⅛		10⅛	
Do. 6 per Cent. Preference	13,	¼	—		—	
Do. 5 per Cent. Debentures, 1899	105,	8	108		106	
Eastern Extension	10⅞,	11⅛	11		11	
German Union	10⅛,	⅛	10⅛		10⅛	
Globe Telegraph and Trust Company.	6⅛,	⅛	6 9-16		6⅛	
Do. Preference	12⅛,	⅞	12⅛		12⅛	
Great Northern	12⅛,	⅛	12⅛		12⅛	
Indo-European	28,	29	—		—	
Mediterranean Extension	2⅛,	3⅛	—		—	
Do. Preference	9⅛,	⅛	—		—	
Reuter's	11⅛,	12⅛	—		—	
Submarine	280,	290	—		—	
West India and Panama	1⅛,	⅛	1⅛		1 11-16	
Do. 1st Preference	7⅛,	⅛	7 5-16		7 5-16	
Western Brazilian	7⅛,	⅛	7⅛		7⅛	
West. Union 7 per Cent. 1st Mortgage	125,	130	—		—	
Do. 6 per Cent. Sterling Bonds	104,	107	—		—	

TELEPHONE.—Wanted for abroad, several thoroughly experienced TELEPHONE MEN. Must understand all details of the business. Also one or two first-class linesmen, who are familiar with the Telephone. References required. Also details as to previous experience. Address by letter only "C. V.," care of Messrs. Kingsbury and Co., Lombard House, George Yard, E.C.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

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For the Advancement of
TECHNICAL EDUCATION.

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COMMENCING OCTOBER 4, 1881.

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Fuel and Illuminating Agents ..... Fridays.
Metals and Metallic Compounds ..... Mondays.

DAY CLASSES (Preliminary).

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Laboratory ..... Tuesdays.

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Electrical Laboratory Apparatus ..... Fridays.

DAY CLASSES (Preliminary).

Lectures ..... Tuesdays and Thursdays.
Laboratory ..... Thursdays.

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Builders' Work, including Sanitary Engineering Thursday Evenings.
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PHILIP MAGNUS,
Director and Secretary.

CITY and GUILDS of LONDON INSTITUTE.
TECHNOLOGICAL EXAMINATIONS.

The next EXAMINATIONS in TECHNOLOGY will be held at the different Provincial Centres throughout the Kingdom on the evening of May 24, 1882.

Teachers desiring to form classes should apply at once to the Director and Secretary of the Institute.

List of subjects in which the examinations will be held and general conditions of payment on results, can be obtained by application to the

Central Office, Gresham College, London, E.C.

PHILIP MAGNUS,
Director and Secretary.

KING'S COLLEGE, LONDON.—EVENING CLASSES IN ELECTRICITY AND ITS VARIOUS APPLICATIONS.—These classes, which are held on Wednesday evenings, from 7 to 8, under the direction of R. E. DAY, M.A., Author of "Exercises in Electrical Measurement," &c., will OPEN on WEDNESDAY, October 12th, at 7 p.m.

The instruction will be specially adapted to meet the requirements of students who are preparing for the Prel. Sc. and First B.Sc. Examinations at the University of London.

The fee for the course, from October to Easter, is £1 11s. 6d., payable in advance in the College office.

THE GENERAL PURPOSES COMMITTEE of the CORPORATION of the CITY of LONDON (by their sub-committee) having under consideration the question of LIGHTING the EGYPTIAN HALL and SALOON at the MANSION HOUSE by means of electricity, desire to receive PROPOSALS with estimates of the cost of carrying the same into effect. Plans and sections of the rooms, and other information may be obtained on application at the architect's office, Guildhall. The Committee will meet at Guildhall on Tuesday, the 11th October next, at 1 o'clock precisely, to receive and consider proposals and estimates.

MONCKTON.

Guildhall, London, 28th September, 1881.

HAMMOND and Co., 110, CANNON STREET, LONDON, Agents and Concessionaires of the "Brush" Electric Light for Lancashire and the North of England, are prepared to give TENDERS for ERECTING ELECTRIC LIGHTS in either private or public buildings.

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TELEGRAPH AND ELECTRICAL ENGINEER,
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.
Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.

NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

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RECENT INVENTIONS.

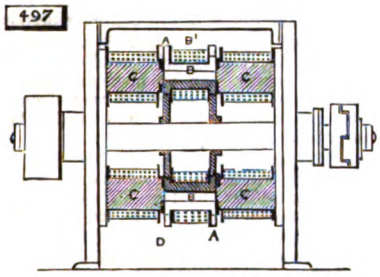
ABSTRACTS OF SPECIFICATIONS.

474. IMPROVEMENTS IN GALVANIC BATTERIES, *J. C. and G. Fuller.—4th February*, 1881.—(*Not proceeded with.*) 2*d*.

The inventors employ in an otherwise complete galvanic element an additional separate porous cell to hold a reserve of the exciting fluid.

497. IMPROVEMENTS IN ELECTRO-MAGNETIC INDUCTION MACHINES, *H. Wilde.—5th February*, 1881. 6*d*.

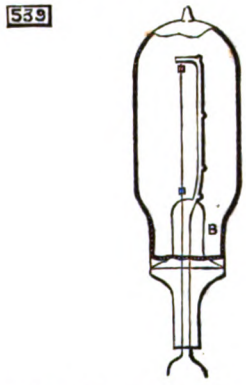
This invention consists of a method of constructing electro-magnetic induction machines with multiple armatures to increase their efficiency. The figure gives a section of the machine. A A are wheels or discs made of brass or other non-magnetic metal, and they are slit in a radial direction towards the centre of each armature, B B are armatures with pole pieces B^1 B^1, the slits in which coincide with the slits in the wheels. The pole pieces are fitted in recesses in the brass wheels A, and are retained in proper position by



screw pins B^2; C C are electro-magnets with pole pieces D slit radially, and about one-half larger in diameter than the diameter of the cores, while the pole pieces B^1 B^1 are about one-sixth larger in diameter than the armature cores. The electro-magnets may be excited by a separate small machine, or by one or more armature coils of the same machine as described in patents Nos. 3,006, 1863; 2,762, 1865; and 842, 1867. When direct currents are employed, an electro-magnet is used which is connected with a switch and excited by a major current; this shunts the current through the machine till the external circuit is re-established, and so avoids sparking on the commutator.

539. ELECTRIC LAMPS, *E. G. Brewer.—8th February*, 1881.—(*A communication from T. A. Edison.*) 8*d*.

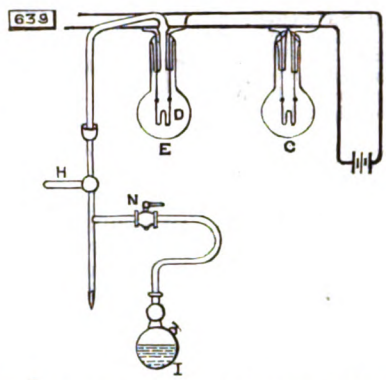
One of the objects of this invention is to make a lamp in which the light-giving portion is in a straight line, as shown in the figure. Upon the glass bulb B is secured a glass arm, D, rising to a little greater height above B than the length designed to be given to the carbon, the arm D then turning at about a right angle. A conductor is either fused into D or bound thereto; this con-



ductor has at its top end a clamp, to which is secured one end of the carbon, the lower end of which is secured in another clamp in connection with another conductor. In manufacturing the lamp the supporting arm, conductors, and carbon are first placed in position upon B, the glass support and enclosing globe are then united and the globe exhausted. The specification also refers to other improvements in incandescent lamps.

639. CARBON FOR ELECTRIC LIGHTING PURPOSES, *W. R. Lake.—15th February*, 1881.—(*A communication from H. G. Maxim.*) 8*d*.

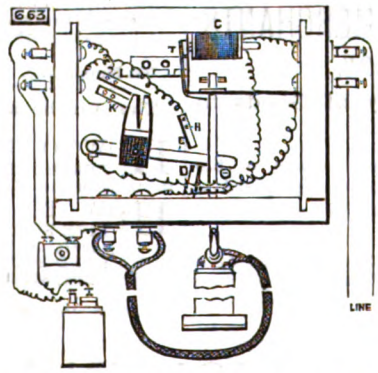
This is a method of making carbon conductors of uniform capacity and resistance. The inventor's apparatus permits of the carbon being tested in comparison with a standard lamp, at the same time that it is gradually added to by the deposition on it of carbon from a surrounding carbonaceous gas, until its light is equal to that of the standard lamp. The apparatus is shown in the figure, H being a tube leading to an exhausting apparatus, and I a vessel containing gasoline or other volatile hydrocarbon oil. The method of using it is as follows:—The cock N being closed the air is exhausted from globe L, after which a



current is passed through the carbon D, to expel occluded gases, which should also be pumped out. Then on opening N the vapour of gasoline will flow from I into the globe, filling it to the required degree. A pressure of about 1in. of mercury is sufficient. Now as the carbon to be treated is of higher resistance than the lamp, it will be found that on switching on the current to the carbon and the lamp a smaller portion will flow through D than through C, and the light developed will be correspondingly less, but as D builds up by the deposition upon it of carbon from the surrounding gas, its resistance gradually falls, permitting an increased flow of current and increased brilliancy of light. When the light is equal to the standard lamp the operation is to be arrested.

663. TELEPHONIC APPARATUS AND SIGNALS THEREFOR, *P. M. Justice.—16th February*, 1881.—(*A communication from H. R. Miller*). 1s.

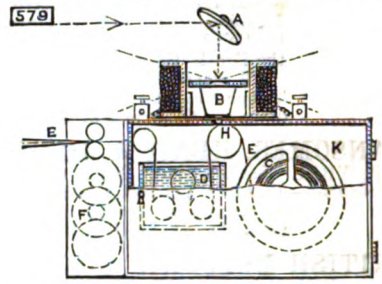
This invention relates to a method of locking out all stations but the sending and receiving stations in a telephonic circuit, and also to an improved electric signal for telephone or other lines. The figure shows the connections. The circuit of the transmitter battery is made or broken by the movement of the prongs actuated by lever E. The magnet C at every station on the line is in the main circuit. Under ordinary conditions, and when no telephones are switched in, the effect of the current is to keep the arma-



ture T drawn up and the rod G unlocked, but when an operator at any given station is called he unhooks and shunts in his telephone, the great resistance of which being brought into line so weakens the current that it will no longer act upon the electro-magnet C sufficiently to draw up the armature, and these armatures in the whole circuit will therefore fall back by their own gravity, and lock all the rods through which the shunting devices are operated, except that from which the telephone has been removed. The operation of the shunting device is as follows:—The rod is pushed up, the shunting lever E is lifted so that it leaves D and is moved upon H, on which it is held by friction; at same time the points of the plate are shifted so as to enclose L and K. The movement of lever from D to H shunts in the telephone, and that of plate I closes the circuit of local battery. The remainder of the specification describes the inventor's new electric signal.

579. ELECTRO-PHOTOGRAPHIC RECEIVERS FOR TELEGRAPHS, *H. Chameroy.—10th February*, 1881. 6*d*.

The inventor arranges his apparatus in several different ways, but space will only permit of our describing one of these arrangements. In the figure A is a mirror; B a truncated cone, swung so as to be movable, and attached to a magnetic needle; C is a drum on which the sensitised paper is rolled; D a bath containing a developing liquid; E the paper; F the clockwork which



draws it forward. The cone B is open above and pierced with two holes on its lower surface, the needle inclining in one or other directions according to the direction of the current, and thus the ray of light striking the mirror is projected through the holes in the cone and through the hole H in the cover of the camera K, striking the sensitised paper all the time the current passes, and consequently produces signs similar to those of the Morse telegraph.

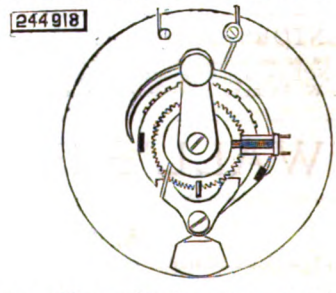
2394. ELECTRIC CIRCUITS, *S. Pitt.—31st May*, 1881.—(*A communication from Dr. S. Lugo.*) 6*d*.

This invention is an improvement on the solenoid formed conductor patented on the 15th March, 1881, No. 1119, and is designed to prevent the interferences arising from the action and reaction upon one another of indirect currents. In the present invention the direct and return conductors are formed into a compound solenoid

consisting of two or more simple solenoids joined together in series and cross-connected at their junctions. A conducting circuit is thus constructed in which the total resistance of the direct and return conductor is substantially the same, while they may be made of wire of similar thickness. The construction of the conductor will be understood on reference to the figure.

244,918. ELECTRICAL SIGNAL TRANSMITTER, *Garret S. Mott, Philadelphia, Pa.—Filed February 14th*, 1881.

Brief.—A transmitter adapted to send signals, but so arranged that no signals will be transmitted while winding. The contact electrode rides back over a spring bridge while in the act of winding.



Claim.—The combination, in an electrical signal transmitter, of a brake plate and rotating carrier having a yielding contact piece, with a pivotted spring lever having one end adapted to bear on the said brake plate in the path of said contact piece, substantially as specified.

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ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians,
86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.
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All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

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Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

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HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
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NEWTON'S PATENT LAW and PRACTICE, Price 2s. 6d.
This standard work contains all legal and other information necessary for intending patentees, including Government charges, agency fees, and rules of the Commissioners of Patents.
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DUNCAN WALLET & CO.,
BONDED STORE AND PROVISION MERCHANTS,
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INVENTORS of any useful improvements in Electric Lamps or Secondary Batteries who are in need of FINANCIAL or other ASSISTANCE can apply by letter, with full particulars, to "ELECTRIC LIGHT," care of J. W. VICKERS, 5, Nicholas-lane, E.C.

JOHNSON'S PATENT TRANSMITTER,
IN COMBINATION WITH
BELL'S EBONITE TELEPHONE.

Unequalled for Telephone Exchange or Private purposes.

ALL ROYALTIES PAID.

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ELECTRIC AND TELEPHONIC ENGINEERS,
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ELECTRIC LIGHT.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

HARBOROW & CO.,
ELECTRIC LIGHT ENGINEERS
AND
TELEGRAPH INSTRUMENT MANUFACTURERS,
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ESTABLISHED 1851.

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Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
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FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

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SLIP

THE ELECTRICAL TRAMWAY IN BERLIN.—An extension of this tramway will, we believe, shortly be opened for traffic.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this company for the week ending the 30th of September amounted to £2,868.

ALGERIA.—News from Tunis, dated the 1st of October, says that the Arabs have broken the submarine cable between Bizerta and La Calle on the day on which it was opened.

ELECTRIC LIGHT AT LEEDS.—In connection with the approaching demonstration in honour of Mr. Gladstone, at Leeds, the Crompton arc light is to play an important part.

ELECTRIC LIGHT FOR THEATRES.—The municipality of Mayence, in France, are about to adopt the electric light in the theatre, in the place of gas, as affording greater security from fire.

DIRECT SPANISH TELEGRAPH COMPANY.—The traffic receipts of this company for the month of September, 1881, amounted to £1,790 against £1,537 in the corresponding period of last year.

ELECTRIC LIGHT AT PENARTH (WALES).—The electric light is reported to have given such satisfaction to the Dock Company at Penarth, that it is their intention to increase the number of the lights.

TELEGRAPHIC EXTENSION IN FRANCE.—Extra wires are being erected between Paris and Marseilles, and two new lines are being constructed between Marseilles and Bordeaux and Cleomont-Ferrand.

THE GOULD CABLE.—The Post Office have at length notified that this cable is interrupted. The fact has been publicly known for about three weeks, indeed the cable lived only some forty-eight hours.

EASTERN TELEGRAPH COMPANY.—The traffic receipts of this company for the month of September, 1881, amounted to £47,407, against £41,717 in the corresponding period of 1880, being an increase of £5,690.

RESTORATION OF JAPANESE TELEGRAPH LINES.—The Great Northern Telegraph Company announce that the Japanese Government lines are again in working order, and that the company's lines to China continue to work well.

ELECTRIC LIGHT AT WOLVERHAMPTON.—At the Exhibition of Domestic and Sanitary Appliances, opened the other day at Wolverhampton, eight of Messrs. Siemens Brothers' arc lights were used to illuminate the building.

AN ELECTRICAL TRAMWAY IN IRELAND.—The first sod of the Giants Causeway and Portrush Tramway was cut the other day. This tramway is to be worked by electricity, the necessary apparatus being supplied by Messrs. Siemens Bros.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The traffic receipts of this company for the week ending the 30th September, 1881, amounted to £1,902, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company.

QUICK WORK.—It is stated that during the *fêtes* consequent upon the inauguration of a statue of Dupont de L'Eure, on the 4th of last month, the telegraphists at Neubourg transmitted during the evening of that day more than 50,000 words by means of 10 Hughes instruments.

INTERNATIONAL ELECTRICAL EXHIBITION.—There is some probability that this Exhibition will not be kept open so long as was expected, as the attendance is falling off considerably. Intending visitors should therefore not count upon its remaining open until Christmas, as has been rumoured.

THE EASTERN EXTENSION TELEGRAPH COMPANY.—The traffic receipts of the Eastern Extension, Australasia, and China Telegraph Company, for the month of September, 1881, amounted to £30,866, against £28,771 for the corresponding period of 1880, being an increase of £2,095.

ELECTRIC LIGHT IN GLASGOW.—It is stated that Messrs. Anderson and Munro, of Glasgow, have had their premises in Kelvin-street fitted up with the electric light. On the ground floor they have the Brockie apparatus in use. The Swan lamp is used in the other portions of the building.

GREAT NORTHERN TELEGRAPH COMPANY.—The traffic receipts of this company for September, 1881, amounted to £22,280, and for the period from the 1st January to the 30th September, 1881, to £179,720, against £176,646 for the corresponding months of 1880, and £152,146 for the corresponding months of 1879.

HONOURS FOR AN ELECTRICIAN.—It is stated that Dr. C. W. Siemens has received from the French Government a formal document nominating him "Officier de l'Instruction Publique," the nomination being accompanied by the insignia of the Order, which corresponds, we believe, to the Prussian Order, "Pour le Mérite."

TELEGRAPHIC COMMUNICATION WITH LIGHTHOUSES.—The Lord Mayor has called a meeting at the Mansion House for Tuesday, October 18, to consider the need of establishing telegraphic communication between lighthouses and lightships and the shores, with a view to prevent as much as possible the great loss of life from shipwrecks on our coasts.

PRICES.—The prices as quoted this week are as follow:—For gutta percha per lb.:—Genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber, fine Para, 3s. 3½d. to 3s. 4d.; negrohead, 2s.; central American, 1s. 5d. to 2s. 2½d.; Assam and Pegu, 8d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 5d. to 2s. 2d.

CONDUCTIVITY OF METALS.—Professor Lorenz, of Copenhagen, confirms the experiments of Messrs. Wiedemann and Franz as to the conducting power of metals for heat and electricity, and finds that the ratio of the conductivities at 0 deg. and 100 deg. is almost constant. In metals of lower conducting power it increases with decreasing conductivity.

CUBA SUBMARINE TELEGRAPH COMPANY.—The number of messages passing over the lines of the Cuba Submarine Telegraph Company during the month of September was 2,105, estimated to produce £2,000, against 1,724 messages, producing £1,710 in the corresponding month of last year. The traffic receipts for the month of July, estimated at £2,300, realised £2,397.

THE IMPORTATION OF TELEGRAPHIC APPARATUS INTO RUSSIA.—According to a Reuter's telegram dated St. Petersburg, the 2nd October, a circular has been issued by the Minister of Finance, directing that galvanic batteries, induction apparatus, and insulated wires imported from abroad shall in future be subject to the same rules of inspection and control as are in force for imported arms.

TENDERS WANTED FOR ELECTRIC LIGHTING.—The General Purposes Committee of the Corporation of London are inviting tenders for lighting the Egyptian Hall and saloon at the Mansion House by means of electricity. Plans and sections of the room may be obtained at the architect's office, Guildhall. The committee will meet at the Guildhall on the 11th instant at 1 p.m. to receive the tenders.

THE TELEPHONE IN SWANSEA.—The Swansea Telephone Exchange Company, which was started in November last year, is making good progress. Over seventy Gower-Bell telephones are in use. The Swansea Corporation offices, five

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police-stations, and the head constable's residence are all connected with this system, and it is expected that before January 1st, 1882, over one hundred instruments will be in use.

TELEGRAPH REPAIRING IN AMERICA.—The work of repairing telegraph lines in America is not the safe and simple affair that it is in our country, as witness the following telegram from New York, dated the 4th of October:—"According to advices received here from Arizona, some Chihuahua Indians have surprised a party of soldiers employed in repairing a telegraph line and killed four of their number."

EASTERN TELEGRAPH COMPANY.—This company announce the proposed payment of a dividend of 3s. per share on the Six per Cent. Preference shares for the quarter ended September 30th, and an interim dividend of 2s. 6d. on the Ordinary shares in respect of the profits for the quarter ended June 30, 1881. The half-yearly interest on the Six per Cent. Debentures will also be paid on October 15th at Messrs. Glyn, Mills, and Co.'s bank.

SPRAGUE v. EDISON.—We understand that the question of granting Mr. Edison a patent for the Webermeter, referred to by Mr. Sprague in a recent issue, was carefully considered by the examiners in the United States office, and that the patent was at first refused; but Mr. Edison made an affidavit that he had constructed his apparatus before the issue of Mr. Sprague's patent, and that he was therefore entitled to a patent in accordance with the American patent law.

H.M.S. "INFLEXIBLE."—The Lords of the Admiralty this week inspected this formidable addition to our navy, which has been fitted with electric lights. A considerable time was occupied in witnessing the ship lighted up by means of the Brush and the Swan systems, this being, it is stated, the first opportunity which their lordships have had of seeing the appliances in perfect working order. As a result of the inspection it has been determined to fit the Brush lights with a shunt arrangement.

ELECTRICAL EXHIBITION AT THE CRYSTAL PALACE.—It is intended to hold at the Crystal Palace, in December next an international exhibition of electricity, at which all the existing systems of lighting will be represented. At the same time it is proposed to form a collection of electrical apparatus generally, including the various forms of telephones, secondary batteries, and a large variety of scientific objects concerned in the production or employment of electricity and magnetism. A meeting has been convened by the Lord Mayor, to be held on the 24th of October at the Mansion House, to consider this subject.

ELECTRIC LIGHT IN DUBLIN.—The Dublin Electric Light Company again made application to the Town Council at a recent meeting for leave to light certain streets by electric lights during the next twelve months, and this request has been referred to a committee, though there does not seem much chance of its being granted. On the matter of opening the streets to lay wires for electric lighting purposes, both the company and the Corporation have sought legal advice, with the result that both have been advised in an opposite sense. We believe it is the intention of the company to apply to Parliament for the necessary powers.

LEGAL.—Before the Tribunal Correctionnel of the Seine in August last the case of Reynier *v.* the Compagnie d'Eclairage Electrique came on for hearing. M. Reynier's case was that in 1875 he had taken out a patent for electro-plating the carbons of electric lamps, in order to render them more durable and to better their conductivity, and that this patent had been infringed by the company in question. The company replied that this method of plating carbons had been employed for several years, and, in fact, that patents for this process had been taken out in France so far back as 1867, and in Russia in 1873. The Court decided against M. Reynier's appeal.

THE ELECTRIC LIGHT.—Alluding to Mr. Staite's letter, stating that the first exhibition of the electric light took place in 1847, given in our last issue, Mr. W. H. Langhorne writes to *The Times* as follows:—"In a book I have, entitled 'Practical Economy,' published by Colburn in 1821, under the head of 'Illumination' this passage occurs:—'Professor Meinacke, of Halle, has just succeeded in producing a brilliant illumination by means of electric light. As the sparks propagate themselves to infinity, the Professor thinks it will be possible to light up a whole city with a single electrifying machine, and at a very trifling expense, by the adoption and probable improvement of the apparatus he has already invented.'"

AN ELECTROPHOTOMETER.—An apparatus of this kind is thus constructed by Dr. Nachs. A wooden case, open at the top and one side, has two compartments one above the other, in the lower of which and at the inside is placed part of a dry battery of 200 cells, and in the outer part a Jacobi rheostat. In the inner part of the top compartment a galvanometer is placed, and in the outer part an adjustable truncated cone, the inner surface of which is blackened, and within which is a small selenium cell on which the light is to fall. The battery, galvanometer, rheostat, and selenium cell are all electrically connected, and the apparatus is ready for work. This arrangement is described in a recent number of *La Natura*.

DEEP-SEA CABLE REPAIRING.—The Eastern Telegraph Company's steamship "Retriever" has succeeded in repairing the direct Porthcurno-Lisbon cable, recovering it in a depth of 1,600 fathoms. The "Retriever" is only 187 feet long, and 250 tons register. She is the smallest ship that has effected repairs in such a depth of water; and the operations reflect much credit upon Captain Madge, commander, and Mr. James Anderson, electrician in charge. All three of the Eastern Telegraph Company's ships, the steamship "John Pender," steamship "Chiltern," and steamship "Retriever," have now proved that they are thoroughly efficient in every respect to deal with repairs in any depth of water in which the cables of the company lie.

ELECTRIC LIGHT FOR CHESTERFIELD.—The Corporation of Chesterfield having some time since quarrelled with the gas company, the latter cut off the supply, and for some weeks the town has been in darkness. As neither side would give way, and as the disadvantage of the present state of affairs became more and more obvious, it was finally decided to try whether a combination of oil and electric lighting would not answer as well as gas. Accordingly Orion oil lamps have already been started in some parts of the town, and the lighting of the remainder by means of electricity was duly considered by the authorities, who received offers from Messrs. Hammond and Co., the British Electric Light Company, and Messrs. R. E. Crompton and Company. The offer of the former has been accepted to supply thirty-four Brush lights, and in consequence it will not be long before the ever falling tower of Chesterfield Church will for the first time look down on the electric light.

SOUTH AFRICAN TELEGRAPHS.—The report of Mr. Sievwright, general manager of telegraphs in the Cape Colony, for the year 1880, states that during the year, besides the opening of new stations on old lines, and the restoration or

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duplicating of existing lines, 524 miles of the new line were constructed. The revenue of the Telegraph Department in 1880 was—from private messages, £41,581; Government messages, £19,248, as against £33,718 and £16,012 respectively in 1879. The number of messages in 1880 was 398,277, and of words 10,806,044, as against 303,068 messages and 8,252,254 words in 1879. The increase in receipts was thus 22·32 per cent., and in the number of messages 31·41 per cent. The revenue for the year from private messages is stated to be over £10,000 in excess of the estimate, and is, for the first time since the transfer of the telegraphs to the Government, in excess of the actual expenditure (£39,335), no account being taken of the Government work. If the value of the latter at the ordinary commercial rates be added, the result is a clear profit of £21,494, being at the rate of 8·09 per cent. on the total capital invested. A marked extension of the use of private wires is reported, and the telephone is largely used, especially in Cape Town, by private firms.

A Curious Application of Electricity.—Electricity would probably be described by a modern Shakespeare as "playing many parts." Now it is used as a means of painlessly performing a medical operation, another time to blow up a Czar's palace; now to light up large docks, at another time to boil a kettle. We hear of an instance from America in which it was used to procure the destruction of a mule by gun cotton, and at the same time to assist in obtaining an instantaneous photograph of the proceeding. The operation was conducted by the Engineer School at Willet's Point, New York, the arrangement of the apparatus, &c., being as follows:—The mule was placed in proper position before a photo camera and duly focussed. Upon the animal's forehead a cotton bag was tied containing six ounces of dynamite. The slide of the camera was supported by a fuse; the camera fuse and the dynamite on the mule's head were connected in the same electrical circuit, and with a key placed at some little distance off. On pressing the key so as to send a current through the wires, both the fuse and the dynamite were simultaneously fired. The camera slide and the head of the animal fell nearly together. The photo sensitive plate was impressed with a picture of the headless creature, still standing, before its body had time to fall.

American Association for the Advancement of Science.—The thirtieth meeting of this association was held from the 17th to the 23rd of August last, at Cincinnati, when the following papers, amongst others, were read:—"Magnetic Survey of Missouri," by Francis E. Nipper; "Numerical Elements of the Orbits of the Seven Electrical Vortices, &c.," by Thomas Bassnett; "The Great Primordial Force," by H. R. Rogers; "On the Electrical Resistance and Co-efficient of Expansion of Incandescent Platinum," by E. L. Nichols; "A Musical Local Telegraph Alphabet," by William Boyd; "Electricity, Magnetism, Gravitation—their Phenomenon Considered as the Manifestation of One Force," by S. S. Parsons; "On the Features of Equivalence to Chemical Elements shown by Electricity and Heat," by Samuel J. Wallace; "Upon the Use of the Induction Balance as a means of Determining the Location of Leaden Bullets Imbedded in the Human Body," by A. Graham Bell; "Upon a New Form of Electric Probe," by the same; "Time Service, Carleton College Observatory," by W. W. Payne; "The Needle Telephone, a New Instrument by Dr. Goodman, of Louisville, Ky." by J. Lawrence Smith; "An Anomalous Magnetic Property of a Specimen of Iron, by the same; "The Electrophone and Electric Lighting," by E. B. Elliott.

College of Science and Arts, Glasgow.—On Monday last Mr. A. Jamieson delivered the opening lecture of the session, his subject being "Electricity as a Lighting and a Power-transmitting Agent." Mr. Jamieson practically illustrated his lecture by means of Swan and Maxim incandescent lamps, and Crompton and Brush arc lamps. He also showed sewing and saw machines, driven by a Gramme dynamo machine, a Faure battery driving a Siemens dynamo machine, and the steering apparatus invented by Mr. King, of Edinburgh, which has been practically used lately on board a Clyde steamer. Mr. Jamieson said that "this ingenious apparatus embodied a principle which would be greatly taken advantage of in the future, not only for the steering of vessels, but also for many other classes of work, where automatic or self-acting action was required. In this particular instrument the ordinary compass, through the aid of a small battery with magno-motor and hydraulic rams, was enabled to steer a ship, however large, on any desired course, admitting at the same time of changing or altering the course when necessary to do so, so that the officer on watch had only to keep his eye on the compass occasionally to see that it was doing its work faithfully." At the conclusion of the lecture a vote of thanks was proposed by Mr. Rowan, President of the College, to Mr. Jamieson.

Fact or Fiction?—To the systematic treasure-seeker a hopeful prospect is opened out by an electrical achievement lately reported to us from the United States. It would appear that, during the summer of 1843, the schooner "Vermillion," laden with copper bars, foundered in Lake Erie during a heavy gale of wind. Her cargo was valued at sixty thousand dollars, and its owners spared no pains or expense to recover it, but in vain. The "Vermillion" had gone down in the deepest part of the lake, and, after several fruitless attempts to discover her whereabouts, the search for her was abandoned as hopeless. Thirty-eight years had elapsed since her loss, when an Erie boat, provided with an electrical apparatus for the detection of metal substances was cruising about the lake one fine morning. Suddenly the person in charge of the machine observed unmistakable indications denoting the presence of metal beneath the surface of the water over which the boat was at that time passing. The bearings of the spot were at once taken, and on the 3rd of last month a couple of divers were conveyed thither and lowered into the lake. They alighted on the deck of the submerged schooner, and succeeded in penetrating into its hold, whence they extracted and brought to the surface one of the long-missing copper bars. The entire cargo has since been recovered. After this successful feat, who can doubt that it is reserved for electricity to solve all the old-standing mysteries of sunken Spanish and Dutch galleons, British treasure ships, and piratical hoards that have defied mere human ingenuity and perseverance for so many years past?—*Daily Telegraph.*

New Book.—The Delegates of the Clarendon Press will shortly publish an "Elementary Treatise on Electricity," by the late Professor James Clerk Maxwell, edited by Mr. W. Garnett, formerly Fellow of St. John's College, Cambridge. The book was commenced about seven years ago, but its completion was prevented by the author's other engagements; so that during the last three years of his life very little was added to the work. After his death the first portion of the manuscript, on Statical Electricity, was found in a finished state, as well as some chapters on Current Electricity. The book has been completed so as to cover the subjects included in the first volume of the larger Treatise on Electricity and Magnetism by a selection of some of the simpler articles from the last-mentioned work. As in the

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larger treatise, the "method of Faraday" has been followed throughout; but no knowledge of the higher mathematics has been assumed, and geometrical methods have been almost everywhere adopted. Very much of the matter contained in the work will, we are informed, be new to readers who had not the advantage of attending Professor Maxwell's lectures at Cambridge, and the whole book bears indelibly the stamp of Professor Maxwell's originality. It is as much unlike any other book on electricity as the "Theory of Heat" or "Matter and Motion" is unlike other books on thermodynamics or mechanics. The Clarendon Press likewise have nearly ready for publication a second edition of Professor Clerk Maxwell's "Treatise on Electricity and Magnetism," edited by Mr. W. D. Niven, Fellow of Trinity College, Cambridge.—*Nature.*

Accidents at the Paris Exhibition.—The correspondent of *The Times* reports in that paper's issue of the 4th inst., the following accidents at the exhibition. He says:—"Yesterday a gentleman was leaning over a balustrade to examine an extremely interesting machine of M. Christofle, when his gold chain made a connection between two conducting wires which happened to be exposed. His chain became red hot and set fire to his waistcoat. To-day I had some conversation with a gentleman who was nearly killed the other day by a Brush dynamo-electric machine. Part of the conducting wire was not insulated and was lying on the floor. He touched the stand of a lamp which formed part of the conducting system. His body then formed a connection through the ground to the naked wire, and contracted his muscles so as to cause his hand to clench the lamp. Ten lamps were in circuit at the time and so much current was passed through him that eight of them were extinguished. He was powerless to unclasp his hand. Every muscle in his body was paralysed. His face was distorted; his lungs were so acted upon that he could scarcely breathe. He could only utter a faint and unnatural cry. The workmen in the place fled from the workshop, believing that some explosion was about to happen. A friend came up and tried to unlock his hand. It was impossible. He then lifted his legs from the ground. This broke the circuit and his hands were released, while burning sparks flew to his hands in the action of breaking the circuit. He was insensible, but has since then greatly recovered, and has devised an improvement to the lamp which will prevent a recurrence of such an accident."

Cable Manufacturing.—The work of cable manufacturing at Messrs. Siemens Brothers' Telegraph Works at Charlton is thus described:—"The materials which are used for the insulation of a metallic conductor are silk, gutta percha, and india rubber. Of these the first, silk, is only used for very fine wires, and in telegraph instruments. Gutta percha can be and is advantageously used in cases where the conductor will not be subject to fluctuations of temperature as in sea cables, but for the majority of cases where such changes are likely to occur, as in the conductors used for military or other land purposes, india rubber is the best possible insulator, and in an ordinary conductor there are no less than three conditions in which the india rubber is applied, viz., solution of pure india rubber, white rubber, and red rubber. The solution is made in benzoline, and the twisted strand of the conductor, after passing through it, is conducted through a heated chest, wherein evaporation having taken place, the wire emerges covered with a firm skin of solid india rubber. The white and red india rubbers are prepared and applied in a different way. The raw material is passed through roughened rollers, and well watered, by which it is cleaned and turned out in a very indescribable shape. It is more like a rough towel of india rubber than anything else. It is now dried and mixed between rollers with various proportions of chalk, red lead, and sulphur, the proportions being varied according as it is wished to turn out white or red rubber. After the mixing is complete the mass is passed between a pair of very close rollers, and emerges in a fine thin sheet, which is passed over the wooden rollers of a carrier to the knives by which it is cut into strips about $\frac{1}{2}$in. wide. After this the various strips are rolled upon reels, which are to serve the machine which receives the conductor, covered as already stated with a coat of pure india rubber. The conductor passes between the circumferences of two grooved wheels, which nearly touch each other, but immediately above and below the conductor come slips of white rubber, which by the edges of the grooves are pressed tightly together and cohere firmly. The superfluous edges of the rubber are cut off by two knives, which are set to the proper distance apart. The section of the rubber and strand has then something of the shape of the planet Saturn and its rings. After this strips of red rubber are applied in the same way, but the joints of this last do not coincide in position with the joints of the white rubber, but are at 90 deg. from these, reckoning round the centre of the strand. Over the red rubber comes a spiral covering of waterproof cloth. This is made by passing calico through a black solution of india rubber, and rolling it evenly upon rollers. After the rolling is complete the spindle is put into a lathe and the cloth cut into the proper width of strips for winding over the india rubber. The speed with which the reel carrying the cloth is carried round the conductor can be set at any desired relation with the speed at which the conductor itself is drawn forward longitudinally, so that the thickness of the cloth covering can be so regulated. After this covering is on, the conductor, wound upon a spool, is vulcanised in a steam chamber at a pressure of 40lb. of steam, and the conductor has then only to be passed through a solution of ozokerit, with a view of giving it an improved appearance, to be ready for use. In a line to be used in a deep sea, as before stated, gutta percha is used, and this is applied directly to the strands. Over the gutta percha comes a spiral coat of jute yarn, which is kept in place by a single strand of the same material wound the other way round. In this form the line is coiled in iron tanks, covered with water, and tested for insulation. Having given satisfaction in this particular, the cable, as we can now begin to call it, is passed through the machine which covers it with a spiral casing of galvanised steel wire, care being taken to keep the jute quite wet while the wire is being applied. The cable then passes through a compound of tar and pitch, and is successively covered by three cases of hemp or Manilla yarn, between which, as well as finally, the black compound is applied. The cable is now complete and is stored in large tanks, some of which hold as much as 500 knots of cable. The various coils are whitewashed as they are stored, to prevent the pressure, to which the under coils are subjected when the tank is full, causing them to cohere. There are twenty such tanks in all, but they are not all as large as those mentioned above. The cable floor, with all the machinery for coating the core, is in duplicate, and it is estimated that when in full work night and day as much as 250 knots of cable can be turned out in a week. On such an occasion the number of *employés* on the whole premises would be about 2,500. It will be remembered that the members of the Iron and Steel Institute are to visit Messrs. Siemens' works next week."—*Engineer.*

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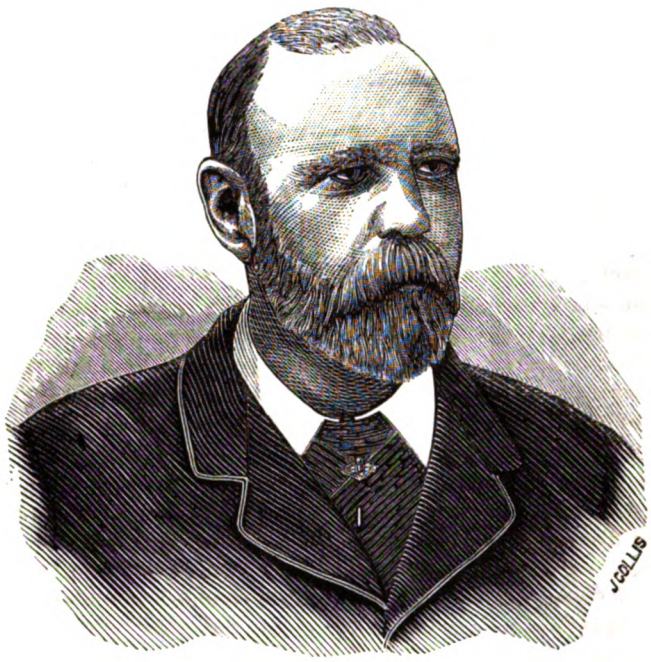
THE LATE COLONEL GLOVER.

In accordance with our promise we now give a few details of the career of the late Colonel Glover—whose death we recorded some few weeks back—together with an engraving from a photograph. Colonel Thomas George Glover, late of the Royal Engineers (Bengal), died suddenly at Neuenahr, in Prussia, on the 12th Sept. last. He entered the military service of the East India Company as a cadet of the Bengal Corps of Engineers in 1844, and was promoted to the rank of first lieutenant in November, 1849, about which time he was appointed an assistant executive engineer in the Public Works Department of the Punjab Circle. During the Punjab campaign of 1848-49 he was actively employed, having been engaged at the first siege of Mooltan, the storming of the intrenched positions on the 9th and 12th of September, the action of Soorjkoond, the capture of the suburbs, the storming of the city, and the final surrender of the fortress. He likewise took part in the capture of the fort and garrison of Cheniote, and also in the memorable battle of Goojerat, which decided the fate of the Punjab, receiving a medal with two clasps for his services during the campaign. Soon after the pacification of the Punjab he was appointed officiating Garrison Engineer at Lahore, and at the outbreak of the Indian Mutiny he was Executive Engineer at Bhirtpore, to which office he was gazetted on the 6th of February, 1857. He succeeded in escaping to Agra, then the seat of Government in the North-West Provinces, and took part in the battle fought there on the 5th of July of the last-named year, being awarded a medal for his services. In 1858 he became captain, and on the 8th of August, 1859, he was appointed Superintendent of the Western Jumna Canals, Punjab, with the rank of a first-class executive engineer, and was engaged in the construction of those great works of irrigation which have tended to the development and fertilisation of the Northern Provinces of our Indian Empire.



He attained the rank of lieutenant-colonel in June, 1866, and in March, 1867, was appointed a superintending engineer of the first class in the Department of Public Works, and subsequently acted for some time as Director-General of Telegraphs. Finally he resigned the Indian service, and retired with the honorary rank of colonel on the 1st July, 1870. On returning to England Colonel Glover was appointed Managing Director of the British Indian Extension and China Submarine Telegraph Companies, which were then just formed for extending telegraphic communication from India to the Straits Settlements, China, and Japan. These companies in 1873 being merged, with the British Australian Telegraph Company, into the Eastern Extension, Australasia, and China Telegraph Company, Colonel Glover's services were retained for the benefit of the new company, of which he remained the managing director up to the time of his lamented decease. It was in this capacity he visited Australia and New Zealand in the summer of 1878, and materially assisted in carrying to a successful issue the negotiations with the colonies for the laying of a duplicate cable to Australia in return for an annual subsidy. Colonel Glover was also a director of the Eastern and the South African Telegraph Companies, and at all times took a lively interest in everything appertaining to the development of telegraphy and scientific progress. He attended the Telegraphic Conferences held at Rome and London. This sketch of his life is necessarily short, and may, in some sense, be said to be a type of the life of the man. Colonel Glover was a worker, not a talker, and his voice was but little heard at the board meetings attended by him. His life was none the less useful on this account, however, and his presence will be missed for many a year by those with whom he was associated. United with his varied abilities Colonel Glover possessed that kindness of heart and genial disposition which endeared him to the many friends in all parts of the world who deeply lament his sudden death. Colonel Glover married, on the 9th October, 1856, Mary Jane, daughter of the late General Charles Herbert, C.B.

VAN HOEVENBUGH'S TYPE PRINTER.

For some few years past this instrument has been employed in most of the principal towns in America for automatically distributing news by means of electricity. The manner in which this system is being carried out is that of connecting the houses or offices of such persons as are desirous of obtaining early news by telegraph wires to a central distributing office, each person paying a certain annual subscription. At the subscriber's house or office is placed an electrical receiving instrument constructed in such a manner that, when actuated by a transmitting instrument which is placed at the central office, it prints in Roman characters upon a continuous band of paper flowing from the instrument the varied news that may be from time to time transmitted. The paper band as it receives the printing drops into a basket placed by the side of the instrument so that a person has merely to pick up the slip from the basket and learn the latest intelligence. Type printing telegraph instruments are by no means new, a variety of instruments have from time to time been invented with this object. Notably the type-printing instrument of Professor Hughes which some years back was introduced into England, and which at the present day is used to a very large extent in connection with the working of the ordinary telegraphic system of Europe. The late Sir Charles Wheatstone also amongst his numerous inventions fer telegraphic purposes, invented an ingenious form of type-printing instrument, but these, besides sundry other inventions of the same class, whilst perfectly fulfilling the object for which they were designed, viz.;—that of facilitating

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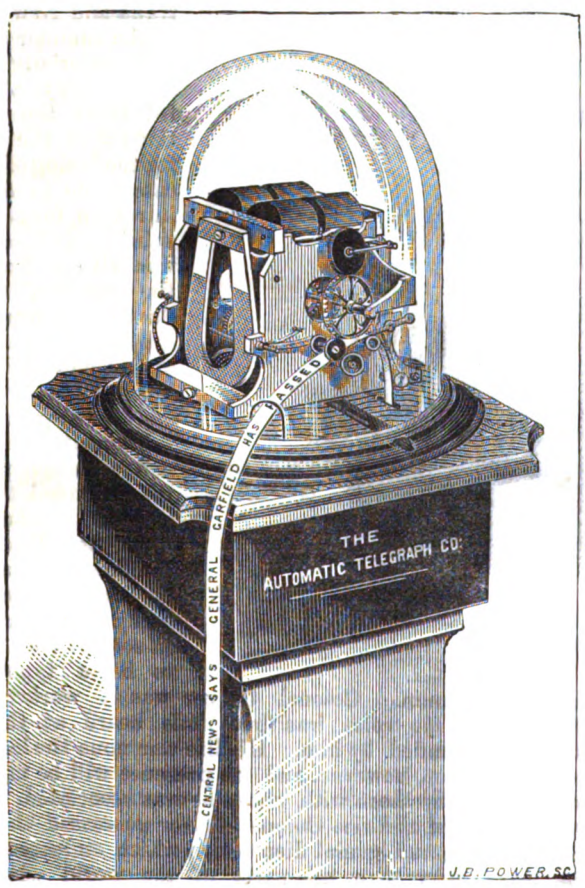
ordinary telegraphic communication, were not suitable for the purpose above-mentioned.

Notwithstanding the marked success that the system has attained in America, little has been done in simplifying the instruments since their first introduction; two line wires and two type wheels being still employed. At the first glance it would appear strange in a country so noted for invention as America that this should be the case, but the reason becomes apparent when we mention that the company who are working the system are extremely influential, and possess what may be almost termed a monopoly in America for this class of telegraphic communication. They have expended a large sum of money in establishing their present system, and so long as the instruments work fairly well do not care to make a change, preferring rather to buy up any new inventions that might possibly at a future date prove formidable competitors, and so keeping in their own hands the control of this particular branch of telegraphy. How far this policy may be advantageous, no doubt the company are well able to judge, besides, if we remember right, it is not without a precedent



in the history of telegraphy, as a very similar policy was pursued by more than one of the old telegraph companies in England prior to the Government taking over the telegraphs.

Upon its becoming apparent that a system similar to that worked in America would be well received in England, and that a general desire existed amongst the proprietors of clubs, exchanges and news rooms for an immediate and simultaneous supply of important items of intelligence, and the probability of it also proving remunerative to supply at the same time the news to hotels, private house and office, the chairman of the Central News (Limited) visited New York in the autumn of last year in order to obtain the most suitable telegraphic instrument for meeting these requirements. He found that General Eckert, the president of the American Union Telegraph Company, had just completed the purchase of an automatic type-printing instrument, invented by Mr. Henry Van Hoevenbugh, chief electrician of the American Union Telegraph Company, who for many years has been engaged in working and perfecting the system of telegraphic type printers. This instrument, which is shown in the accompanying drawing, is worked upon a single wire which reduces both the liability of faults and expense of erection and maintenance of lines. At the same time the speed of working has been increased, and it is stated that this receiving instrument does more work on a single line than those of a prior date were capable of getting through on two lines.

These instruments have now been in constant work since the opening of Parliament on the 6th January last, and by their means not only have reports of the proceedings in both Houses been daily telegraphed in printed characters to a number of newspaper offices, but many of the large West End clubs and other places have been supplied with general news of the day.

At the central office is placed the transmitting instrument, in connection with which are a number of single telegraph lines that radiate from the office and connected at the various places, *en route*, with the receiving instruments of the different subscribers. This transmitter is furnished with a keyboard somewhat resembling the keys of a piano, and connected with an electric battery in such a manner that a series of reversals, that is to say, positive and negative currents can either be sent or not by the manipulation of the keys. Now, so long as these currents of electricity are flowing out to the lines, and hence through the whole of the receiving instruments, it can be readily understood that they can be made to act upon the revolving type-wheels of the receiving instruments, which are made to rotate the distance only of one letter for each current that is sent. The keys on the keyboard correspond with the letters of the alphabet, figures, and other characters which it has been found desirable to place on the type-wheels. By depressing any one of these keys the reversed currents are instantaneously arrested, so that the type-wheel of each receiving instrument is simultaneously stopped at the particular letter or character corresponding to the key depressed. Now the moment the type-wheel ceases to revolve, the printing lever, which is placed below the type-wheel in front of the instrument, by a simple contrivance strikes the band of paper that is to receive the printing against the type on the wheel, and so prints the desired character; on the printing-arm falling, the paper is made to advance the necessary space ready for the next letter. From this it will be seen that an operator at the transmitting instrument can, by the manipulation of the keyboard, cause every one of the receiving instruments throughout the whole of the system to print any desired letter. In order that the instruments may be more thoroughly under the control of the operator at the central station the receiving apparatus is fitted with a simple and ingenious form of unison which can be called into play at will by the depression of a key on the transmitter for that purpose, and by this means every one of the type-wheels can be set at zero should it be required. The object and necessity of this unison is self-evident, for it enables the operator to be perfectly certain before commencing the transmission of a message that every one of the receiving instrument type-wheels are started from the same position.

Electric Light for Picture Galleries.—A. M. Kurner writes in *Le Gaz*, of Paris, an article on the ill effects produced by using the electric light in picture galleries, in which he states his opinion that many pictures are quite spoiled by the light, which makes them look ghostly and wan. M. Kurner thinks that it is a case of a duel between art and the electric light. He acknowledges that the latter will not give way, but he is of opinion that the former will not either. We believe M. Kurner is talking of the arc light only, and if so we can quite concur with his words "ghostly and wan;" but surely the same thing cannot be said of the incandescent lamp, the Swan for instance, the colour of which is a soft yellow. And again, why not surround the arc light with tinted glass, as has been done before now, so as to obtain the colour most suited to the paintings. This is not very difficult of accomplishment.

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CORRESPONDENCE.

STANDARD RESISTANCE UNITS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: While the subject of a new reproducible resistance or standard ohm is under consideration any practicable suggestions may be serviceable. It is proposed to define a certain column of mercury as the standard. This has great theoretical advantages, because mercury is easily obtainable in purity, and, being liquid, it has no molecular work to be done upon it, and its crystalline and physical conditions can undergo no changes such as may occur in wires of either pure metal or alloys. But will there not be a great practical difficulty in producing a column of mercury of the exact dimensions required? How are we to ensure the production of tubes strictly accurate of the defined section, be it a millimetre square or circular?

My suggestion is that this difficulty may be overcome by not defining any section of the containing tube at all. Measurements of length and of weight are practicable to the extremest delicacy. If, therefore, we form an angular trough, as by fixing together two strips of ebonite (which may be covered over by a plate where it is desired to preserve a standard, or, if necessary, in other cases to prevent action of air or moisture), we need only define its length and the exact weight of mercury to be placed in it. We shall then have an instrument easily constructed, and not exposed to the many sources of error in construction and of variation which will affect any tube which is to be filled with mercury.—Yours, &c.,

J. T. SPRAGUE.

SECONDARY BATTERIES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In reply to the letter which appeared in your last impression, signed "W. Lachlan," will you allow me to inform that gentleman that in July last I did call at No. 446, Strand, for the purpose of purchasing a few of the batteries, and of gaining what information I could as to the mode of charging, &c. The result of my interview with M. Faure on that occasion was not satisfactory, and I was informed that they had only just sufficient batteries in hand for their own use, but were expecting a supply from Paris, from which they would let me have what I required as soon as they arrived. Since then I have made two more applications with the same result.

By the way Mr. Lachlan writes I presume he is connected with the establishment he names in the Strand. If so, I should be glad if he would allow me to purchase six of the batteries, which I promise to thoroughly test, and the results shall be published. I am sure no one will rejoice more than I if they approach anywhere near what was shadowed forth in Sir Wm. Thomson's letter in *The Times* of the 9th June last.—Yours, &c.,

WILLOUGHBY SMITH.

Wharf-road, City-road, London, N.,
October 4, 1881.

VOLT-WEBERS, KILOGRAMMETRES, AND HORSE-POWER.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The paper on measures of incandescent lamps by Sir W. Thomson and Mr. Bottomley, in your number of Oct. 1, calls for some comment.

The column of numbers headed volt × webers ÷ 10 = kilogrammetres consists of the product of the numbers of volts and webers divided by 100, which I fail to reconcile with the heading. Further, the heading itself is wrong. The column of h.-p., whether it is right or wrong, does not correspond at all accurately with the kilogrammetres.

I have endeavoured to disentangle the calculation, but cannot be sure how it was arrived at. The simplest mode of checking it will be to compare the equivalent of volt-webers in h.-p. derived from these tables with that derived from the numbers given in Sir W. Thomson's Presidential Address, which agrees sufficiently nearly for practical purposes with the formulæ as I understand them. 80,000 volts on 240 webers give 19,200,000 volt-webers. The equivalent of this is taken to be 26,250 h.-p. Dividing, we find 1 h.-p. equivalent to 731 volt-webers nearly.

Taking the first set of numbers in the first table in your paper of Oct. 1, we get 688 volt-webers to ·093 h.-p.; whence dividing, we find 7,400 volt-webers for 1 h.-p., or about ten times as many volt-webers per h.-p. as in the former case, and this proportion is maintained throughout. One of the two equivalents must be wrong.

For clearness sake, I give the deduction of the constant from the values of volt and weber, both according to the C.-G.-S. and gramme-metre-second systems. The values are

	Gramme-metre-second.	C.-G.-S.
Volt	10^5	10^8
Weber	10^{-2}	10^{-1}

Gramme-metre-second System.

$$\text{Volt} \times \text{weber} = 10^5 \times 10^{-2} = 10^3 \times \text{unit.}$$

And substituting $\frac{\text{gramme-metre}}{g}$ for absolute unit,

$$\text{Volt} \times \text{weber} = 10^3 \frac{\text{gramme-metres}}{g} = \frac{\text{kilogrammetre}}{g},$$

where g is about 9·81.

C.-G.-S. System.

$$\text{Volt} \times \text{weber} = 10^8 \times 10^{-1} = 10^7 \text{ unit.}$$

Substituting $\frac{\text{gramme centimetre}}{g}$ for unit,

$$\text{Volt} \times \text{weber} = 10^7 \frac{\text{gramme centimetres}}{g}$$

$$= 10^5 \frac{\text{gramme metres}}{g}$$

$$= 10^5 \frac{\text{gramme metres}}{981}$$

$$= 10^3 \frac{\text{gramme metres}}{9{\cdot}81}$$

$$= \frac{\text{kilogrammetre}}{9{\cdot}81}.$$

To pass to h.-p., we only need to remember that 76·04 kilogrammetres go to an English h.-p., or, for all practical purposes, 76. The French *force de cheval* is 75 kilogrammetres. Putting, therefore, the kilogrammetre = 1-76th h.-p., we get—

$$76 \times 9{\cdot}81 \text{ volt-webers} = 1 \text{ h.-p.}$$

Say 746 volt-webers = 1 h.-p.

Applying this value, the entries of h.-p. in the tables under discussion become multiplied by about 10. Indeed, a casual inspection is enough to raise a doubt as to the smallness of the power stated when compared with the large currents and potential employed. The currents appear so large as to cast some doubt on the measurements. They make the resistance of the lamps, *neglecting that of the battery*, from three to four ohms only as deduced from the measurements. This seems hardly possible.

I only write with a view of getting matters cleared up. There is obviously something wrong.—Yours truly,

R. H. M. B

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THE ELECTRICIAN.

TO CORRESPONDENTS.

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THE SEAMY SIDE OF THE TELEGRAPH.

In the midst of the indignation aroused by the "cornering" operations which have lately been exposed in the chief centre of our cotton trade, it was only natural that the telegraph should come in for some share of the blame. It is much easier, besides being safer, to reprobate a thing than to openly assail an individual; and while there is much righteous indignation exhibited against the wrong doers in general, it is aimed most directly at what are called the *facilities* for wrong doing. Foremost amongst these facilities undoubtedly stands the telegraph; and it is, therefore, roundly accused of being the prime instrument of a vast deal of financial plundering. We do not mince the word, for it is impossible to class the practices lately brought to light in the Cotton Metropolis among the legitimate operations of either trade or finance. What we demur to is that the telegraph is responsible. If the writer in this month's *Nineteenth Century*, who briefly treats on the subject of "corners," had been as explicit in his charges against the wielders of the inoffensive agent as he is against the agent itself we should have had no fault to find with him; but in effect he sets most of the mischief down to the telegraph, and people who take a pessimist view of affairs might consequently be inclined to wish the telegraph banished to the place where political economy is said to have gone, if the disorganisation of trade is the price we have to pay for it.

Of course Mr. Halhed, the writer of the article on "Commercial 'Corners'" we are referring to, does not go this length; nor probably is there anybody living seriously desirous of impairing our means of communication because they are liable to be used for sinister purposes. But it may be well to draw attention to the reverse of the picture, and while admitting that there is a seamy side of it, to claim for it what is rightly its due. There are some inventions which almost from the very first have suffered by reason of ugly associations. Dynamite and nitro-glycerine provoke a shudder at the mere mention of them in these days, and even gunpowder must have had a bad time of it in the reign of James I. For the telegraph, however, everybody has had a kindly and grateful word to say until now; and although its mission is by no means jeopardised we may be naturally jealous of its fair reputation.

There is no denying that this convenient and, for the most part, harmless invention has been made to serve very questionable practices. It is notorious that gambling on the Turf has greatly increased under its ministrations, and that speculation on the Exchange has been fostered by its aid. It is probable, indeed, that both these branches of industry will go on increasing. Trading in "futures" is largely due to the growing rapidity with which news can be interchanged between the country where cotton is grown and those countries where cotton is wanted. The same process is threatened with regard to horse racing. An American paper lies now before us, and among news from "The Old World" we notice an item headed "Suspicions that Lorillard's Iroquois is being jockeyed," followed up by the intimation that "none of the [London] sporting papers *yesterday* name him as the winner." This was printed in America on the day of the St. Leger, and is accompanied by the latest London betting in detail. There is, therefore, some ground for apprehending that wherever and whenever it can, as in these cases, serve the ends of those idle persons who have plenty of wits and an overmastering greed after money, the telegraph will be liberally patronised by them. We cannot prohibit the adventurer from using the telegraph, and the telegraph cannot be blamed if that class of person thrive and multiply. Possibly the moralist may find some consolation in the fact that the telegraph wires are made the vehicle for messages which are in the highest degree proper. The same paper we have just now quoted from informs the American public that "the meetings of the Methodist Œcumenical Council" is "the overshadowing topic in London," and gives a great many particulars of this overshadowing topic which we on this side of the Atlantic had sinfully overlooked. We are also informed, or rather the American reading public are informed of "The Irish People Becoming more Reconciled to the Provisions of the Land Act." In this case we have taken the evidence as read, contenting ourselves with the heading and its big capitals, lest our faith might be shaken. Nobody will take exception to such news as this, unless it be on the score that we who have a stake in the matter are forbidden to believe it.

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Glancing at the columns of telegraphic intelligence from this and every country in Europe, all up to date, we cannot but be gratified that our American cousins continue to take such a warm interest in us and our surroundings.

It would in all seriousness be idle to combat the notion that the telegraph is in the least degree an offender in this relation. Many foolish and improper messages are signalled by means of electricity, just as many unwise and unrighteous missions were undertaken on horseback before even stage-coaches were dreamed of. The fault is not in the machinery, but in the human hands that set it going. The outcry against "cornermen" will, it may be hoped, do good service in awakening public conscience as to the true bearings of their transactions. They were no less iniquitous when they were fewer. That the telegraph has made them more numerous is not wholly to be regretted if public opinion, which moves but slowly, is at length brought to see their true enormity. When things get to their worst they are sure to mend is a saying that is true of the facts of life, though it does not content the impatient moralist. And if anything will hasten the bitter end, and land us quickly at that crisis which enables us to mend our ways, surely it is none other than the telegraph. The tolerance allowed to sins of small consequence will not be extended to those of great magnitude; and the telegraph more than anything else makes them grow hugely. For our part we are not sorry that this should be the case. If, as Carlyle tells us, we want a new soul in matters commercial, the sooner we get it the better; and if the sins committed by the old Adam with the help of the telegraph induce us to put on the new Adam a few years earlier than we otherwise should do the telegraph will deserve our gratitude. The true criminal is the unscrupulous user. He has made himself conspicuous, notorious, hateful, by prostituting an innocent medium of social and commercial intercourse; and it may be hoped that the rope that has been given him without stint will speedily hang him without mercy.

THE ELECTRICAL EXHIBITION AT PARIS.

Miscellaneous Exhibits.

Telegraphy.

The Paris Exhibition will prove a veritable happy hunting ground to every electrician interested in the development of telegraphy. Here will be found examples of some of the oldest side by side with the most modern instruments, whilst the intermediate period is fully represented. As is well known the first attempts to actuate telegraphs by electricity were by means of static electricity, and it is easily understood how all such attempts must necessarily fail. Mr. A. Jones in his lectures divides into four periods the efforts made to establish electric telegraphs. First, from the development of electricity by friction to the discovery of galvanism, or the production of electricity by the chemical action of acids upon metals, in 1790 by Galvani, and by Volta in 1800. Second, from 1790 to 1830, when Oersted published his discoveries on electro-magnetism, and Ampère showed its applicability to telegraphic purposes. Third, from 1820 to 1831, when Professor Henry's discoveries on magnets and batteries were made known. Fourth, from 1831 to 1852, the date the work was published. We might, perhaps, prefer to take the third period from Oersted's work to that of Daniell, and to make a fourth and fifth period, viz., fourth from Daniell to the introduction of the telephone, and fifth from the introduction of the telephone to the present time.

In 1726 Wood discovered that the electric current could be conveyed a long distance by conducting wires. Except perhaps by means of several lectures and papers by Dr. Richardson, F.R.S., we fear that electricians of the modern school have never given due credit to Stephen Grey for his experimental work. No person who ever applied himself to the study of electricity was more assiduous in making experiments, or had his heart more entirely in the work. Although not directly concerned with the Paris Exhibition, we may perhaps be pardoned for referring at some length to Grey, in order to have our article a more complete *resumé* of telegraphic development. In 1729 Grey found that he could not by rubbing, &c., make metals attractive, and was led to try a glass tube 3 feet 5in. long, and about 1·2in. diameter. Each end was fitted with a cork to keep the dust out when the tube was not in use. His idea was to try if he could find any difference in the attraction of the tube when both ends were stopped or both open. In the course of the experiment he held a down feather near one end of the tube, and found that it would fly to the cork, being attracted and repelled by it as well as by the tube itself. He then fixed an ivory ball upon a stick of fir, about 4in. long, when, thrusting the other end into the cork, he found that the ball attracted and repelled the feather. He then used longer sticks, pieces of brass and iron wire, and with success. A long wire being awkward to manage, he hit upon the idea of hanging the ball on a piece of pack thread and suspending it by a loop in the tube. The experiment was successful. After trying these experiments with the longest light canes and reeds he could conveniently use, he ascended a balcony 26ft. high, and fastening a string to his tube found that the ball at the end of it would attract light bodies in the court below. He went higher, and still with successful results. But there was a limit to the height from which he could experiment, and he commenced to try the horizontal instead of the vertical. In his first trial he made a loop at each end of a piece of pack thread, by means of which he suspended it, at one end, on a nail driven into a beam, the other end hanging downwards. Through the loop hanging down he put the line to which his ivory ball was fastened, fixing the other end of it by a loop on his tube. After this preparation he put leaf brass under the ivory ball, and rubbed the tube, but not the least sign of attraction was perceived. Upon this he concluded that when the current came to the loop of packthread it went up the same to the beam, so that none or very little went to the ball, and he was for the time at a loss how to act. On June 30th, 1729, Grey paid a visit to a friend, Mr. Wheeler, to whom he showed some of his experiments, and explained his failure. *Mr. Wheeler suggested that the line to be electrified should be suspended by silk instead of pack thread*, and on trying the experiment the friends succeeded far beyond their expectations.

Here there was a grand discovery. Dr. Noad in his lectures, speaking of Grey, says:—"It was this experimentalist that introduced the distinction between electrics and non-electrics, conductors and non-conductors." We have briefly described the experiments that led Grey to continue his researches and to ultimately make this distinction. It was on July 2, 1729, that the experiment was made in the gallery at Mr. Wheeler's house. "About 4ft. from the end of the gallery they fastened a line across the place. The middle part of the line was silk, the rest pack thread. They then laid the line to which the ivory ball was hung, by which the electric virtue was to be conveyed to it from the tube, and which was *eighty feet and a-half* in length, across this silken line, so that the ball hung about nine feet below it. The other end of the line was by a loop fastened to the tube, which they excited at the other side of the gallery. After this preparation they put the leaf brass under the ivory ball, and upon rubbing the tube it was attracted and kept suspended for some time." (Priestley, vol. i., p. 38, 3rd Ed.) They wanted to try longer lengths, and so doubled the line back again along the gallery with success; they then carried the line (now 124 feet long) from the gallery to the barn with better results than when it was doubled back in the gallery. On July 3 the experiments were continued, and the silk happening to break they tried a small iron wire, but this also broke, and then they used brass wire; but the brass wire, though it supported the line very well, did not answer the

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purpose, for on rubbing the tube they perceived no electricity at the end of the line.

The result of the experiments convinced them that success depended upon their supporting lines being silk, and not, as they had at first imagined, upon their being small. On coming to this conclusion they continued their labour of love, and actually conveyed the current over 765 feet, nor did they perceive that the effect was sensibly diminished by the distance, *vide Phil. Trans.*, vol. vii. In August, 1729, Grey found he could obtain his results by holding the excited tube near his line, but without touching it, in fact inductively. We cannot, however, pursue Grey's investigations further. They are of exceeding interest, they are far too little known, and yet they indicate the real time when telegraphic investigation commenced.*

In eight memoirs in the History of the Academy of Sciences for the years 1733, 1734, and 1737, we have descriptions of M. du Fay's experiments and discoveries. Among other work he repeated the experiments of Grey, and observed that the experiment succeeded better when the pack thread was wetted, and successfully made the experiment with 1,256 feet of line, when the wind was high, the line making eight returns, and passing through two different walks of a garden. The Abbé Nollet assisted Du Fay in most of his experiments.

Jones, in his work, speaks of Winckler as discharging a Leyden jar through a wire of considerable length, and that the river Reis formed part of the circuit. We are unable to verify this statement, as we do not know which edition of Priestley's work Mr. Jones quotes from, but there is no such statement in the third edition of Priestley. We may say that Winckler was professor of languages in the University of Leipsic, and, we believe, published several works on electrical subjects. We shall be glad if some reader acquainted with these works will describe Winckler's experiments.

In 1747, Dr. Watson was carrying out a series of experiments in order to ascertain the distance to which an electric shock could be carried and the velocity of the current. He planned and directed all the operations, and was present at every experiment. His chief assistants were Martin Folkes, Pres. R.S.; Lord Charles Cavendish, Dr. Bevis, Mr. Graham, Dr. Birch, Mr. Peter Daval, Mr. Trembley, Mr. Ellicott, Mr. Robins, and Mr. Short. The first attempt these gentlemen made was to convey the electric shock across the river Thames, making use of the water of the river for one part of the chain of communication. This they accomplished on the 16th and 18th July, 1747, by fastening a wire along Westminster Bridge. One end of the wire was connected to one coating of a charged Leyden jar, the other coating being connected to an observer who held in his other hand an iron rod, which he dipped into the river. On the opposite side of the river stood a gentleman who also in one hand held an iron rod which he dipped into the river, in the other hand a wire with which to make contact with what we may call the line wire. Upon making contact the shock was felt by the observers on both sides of the river, but more strongly by those on the same side as the machine. On the 24th July, 1747, another series of experiments was performed at Stoke Newington, in one of which the distance over which the current passed was land 800ft., water 2,000ft.; in the other the distance by land was 2,800ft., by water 8,000ft. The apparatus was arranged similarly to that at Westminster. Subsequent experiments showed that the water did not form the whole of the return circuit, but that the return circuit was partially water, partially land, and they found on repeating the experiments that it was not necessary to dip the rods into the water, as they obtained shocks when the rods were stuck into the ground. On the 14th of August, 1747, they experimented at Shooter's Hill to obtain more definite information as to the conducting power of dry ground. Only one shower of rain had fallen during the preceding five weeks. The observers were two miles apart, the insulation of the wire being obtained by carrying it all the way upon baked sticks. Further experiments were tried, but to these investigators the passage of the current, even through more than 12,000 feet of wire, appeared to be instantaneous. It is said that Dr. Watson was the first to suggest the use of electricity for telegraphic purposes

In 1748 Benjamin Franklin in America set fire to spirits by an electric current sent across the Schuylkill by means of a wire, the return circuit being the river and earth. De Luc, in 1749, made a series of experiments, in which Lake Geneva formed part of the circuit. Arthur Young, in his "Travels in France," during 1757, writes of an interesting apparatus he then saw, which shows a most decided step in the progress of sending signals by electricity. He says:—"Mr. Lomond has made a remarkable discovery in electricity. You write two or three words upon paper; he takes them with him into a chamber, and turns a machine in a cylinder case, on the top of which is an electrometer, having a pretty little ball of pith of a quill suspended by a silk thread; a brass wire connects it to a similar cylinder and electromoter in a distant apartment, and his wife, on observing the movements of the corresponding ball, wrote the words which it indicated. From this it appears that he had made an alphabet of movements; and as the length of brass wire made no difference, you could correspond at a great distance, as, for example, to a besieged city, or for purposes of more importance."

In *Scott's Magazine* for 1753 is a most interesting letter signed "C. M." A copy of the work containing this letter is exhibited by Mr. Latimer Clark. This letter contained most definite proposals for applying electricity to telegraphy, but we do not hear that "C. M." (Charles Morrison, of Greenock) carried his ideas into practice. He suggested wires, equal in number to the letters of the alphabet, extended horizontally between two places. The wires were to be cemented by jeweller's cement, or fixed in glass to insulate and support them. He clearly explains the arrangement of the whole apparatus, and says:—"Having set the electrical machine a-going as in ordinary experiments, suppose I am to pronounce the word *Sir*. With a piece of glass or any other *electric per se*, I strike the wire *S*, so as to bring it in contact with the barrel, then *i*, then *r*, all in the same way, and my correspondent, almost in the same instant, observes these several characters rise in order to the electrified balls at his end of the wire." Modifications in the apparatus are discussed, and altogether the letter shows a wonderful grasp of the capabilities of electricity.

In *Voigt's Magazine* (according to Turnbull) for 1794 there is a letter from Reusser of Geneva, in which he describes an electric telegraph. "This contrivance consisted of a number of slips of tin-foil fastened on a glass plate, each strip having a different letter marked on it, and connected by carefully insulated wires in glass tubes with a corresponding glass plate at a distance. Thus there was a separate wire for each letter, and one return wire for the whole series. Signals were transmitted by sending electric shocks through the different wires, and noting down the letters attached to the strips of tin-foil where the sparks were observed. The attention of the observer at the distant station was drawn by firing an inflammable air pistol attached to the apparatus by means of an electric spark." Professor Boeckman improved upon this, proposing to choose as the signals the sparks passing at the distant station, using only two wires, by which first one, and then after certain intervals a grouping of sparks, would indicate certain letters. In 1795 Cavallo suggested another modification, that the firing of the pistol, or firing of pistols should form a code for the transmission of signals. We conclude this part of our paper with another extract from Turnbull, who says:—"The *Madrid Gazette* of 25th November, 1796, states that the Prince de la Paix having heard that M. F. Salva had read to the Academy of Sciences a memoir upon the application of electricity to telegraphing, and presented at the same time an electric telegraph of his own invention, desired to examine it; when, being delighted with the promptness and facility with which it worked, presented it before the king and court operating it himself.

"After these experiments the Infanta Don Antonio desired another more complete telegraph, and occupied himself in

* We shall at the earliest convenient opportunity give a detailed account of Grey's work.—[Ed. *E.*]

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testing the quantity of electricity that would be required by the telegraph at different distances, whether on land or water. Two years after the Infanta Don Antonio constructed a telegraph of great extent on a large scale, by which the young prince was informed at night of news in which he was much interested. He also invited and entertained Salva at Court. According to Humboldt, a telegraph was established in 1798 from Madrid to Aranjuez, a distance of 26 miles. Other writers affirm that M. Bebancourt established a line of telegraph between the same places in 1787."

In the continuation of this article we shall enter the domain of the Exhibition, where we find apparatus dating from the earliest years of this century.

Dynamo-Electric Machines.

Professor Jüngerson, of Copenhagen, shows a dynamo-electric machine which has excited the curiosity of everyone concerned in such machines that has visited the Exhibition. According to the designers, the machine develops with a given motive power far better results than any other machine of the same weight and dimensions. It embodies a suggestion that has often been made, but, so far as we know, never before practically carried out, or rather, submitted for public inspection. The present writer, in conjunction with a well-known engineer, designed a machine two years since to embody the same idea, but, like many other things, pressure of work caused the designs to be laid aside till a favourable opportunity occurred for constructing the apparatus. The idea, too, has been mentioned in several patents, but, as we have already said, Professor Jüngerson has carried the idea into practice. The best way to improve any machine is to study its defects. When these are thoroughly understood, it is time enough to construct a new machine to introduce improvements. Taking the Gramme machine as a type of dynamo machine, its defects have been long known; but whatever defects it may have, it is an excellent machine, and being so, it becomes a delicate question whether the introduction of improvements to obtain, say, from 2 to 5 per cent. better results will really prove economic. Let us explain our meaning. Professor F. Jenkin says in his admirable little book on electricity:—"The currents obtained from magneto-electric machines are obviously the result of mechanical work. We expend work at a certain rate, usually described in terms of the horse-power employed in driving the machine. The useful effect of the horse-power thus expended is represented by a certain quantity of electricity driven through conductors under the action of electromotive force." Now, if a given machine gives certain results, and we then add some improvement to the machine indicated by theory, it may be that proportionally a greater percentage of horse-power will be required with the improvement, as thus introduced, to obtain a certain effect than was required before the improvement was made. Again, quoting Professor Jenkin, who continues:—"The work which the current represents is proportional to the product $i\ q$, where q is the whole quantity of electricity moved under the electromotive force i in the time t; then the rate of useful work per unit of time is $\frac{i\ q}{t}$ or $i\ c$. If the efficiency of the electro-magnetic engine is constant under different circumstances, we shall, therefore, find the product $i\ c$ directly proportional to the horse-power expended in driving the machine." That is, twice the *useful* work takes twice the horse-power, and so on. If, however, the proportion of horse-power expended to useful work obtained increased with an alteration, such alteration would not be good. The figures given by Professor Jüngerson relating to his machine seem to indicate a real improvement; the machine will, however, if possible, be put under trial before the close of the Exhibition.

The ordinary form of the Gramme machine is well known. The essential feature is a soft iron ring wound throughout in the same direction with a continuous insulated copper wire, the terminals of which are joined together, so that the whole constitutes an endless wire helix. This ring is known as the armature of the machine, and revolves between the poles of electro-magnets. According to the explanation of the action of this ring by M. Gaugain, and accepted by M. Niaudet in the new edition of his work on electric machines, the interior of this ring does not traverse the magnetic field, and is, therefore, to a certain extent, useless. Professor Jüngerson attempts to utilise this portion of the ring. The

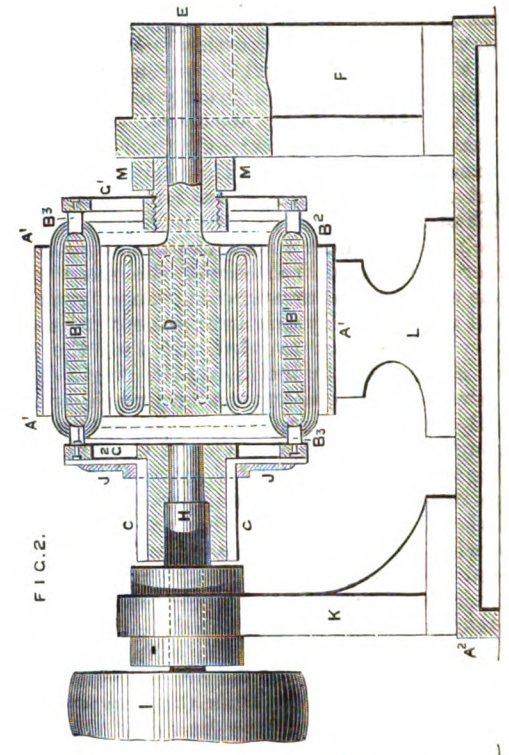

FIG. 2.

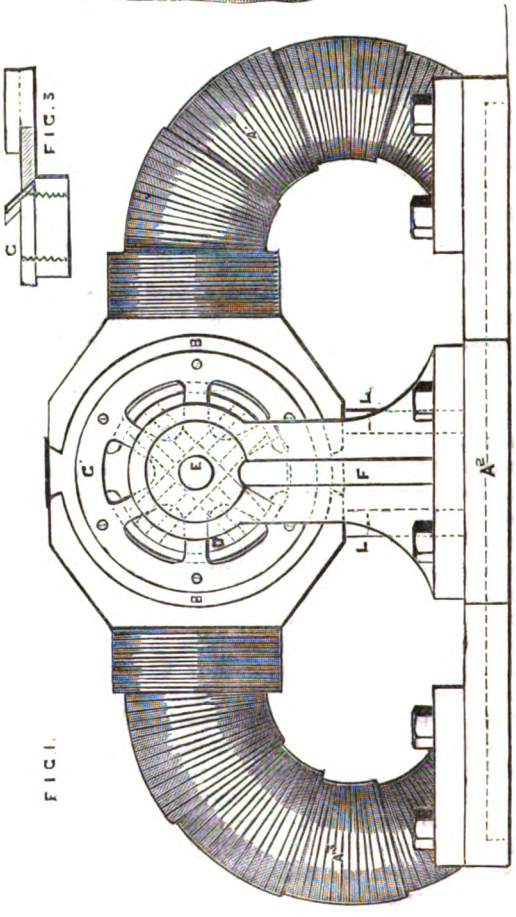

FIG. 3.

FIG. 1.

JUNGERSON'S DYNAMO-ELECTRIC MACHINE.

illustrations herewith given will show at once the peculiarities of Professor Jüngerson's machine and its general resemblance to that of Gramme. We have the electro-magnets indicated by A_1, A_2, A_3, forming a horseshoe magnet, the poles of which are extended like those in the Gramme

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machine, in order to encircle the armature as much and as closely as possible. The armature also is cylindrical, like that of Gramme; but, as we shall see, is not wound quite similarly. The main feature of the machine, and the one by which it altogether differs from previous machines, is that it has fixed internal magnets inside the armature, so that the armature revolves between two magnets instead of as in the Gramme machine revolving within one. The opposite magnets are similar in name, and the inventor states that the introduction of these magnets greatly increases the magnetic influence on the revolving armature. Professor Jüngerson states that Siemens had previously tried to introduce the interior fixed magnets, but that the experiments failed because the right method of winding was not adopted, and he attributes his own success to the plan he has adopted in winding.

In the machine under review the armature is composed of a number of rings of iron wire of the same size, insulated from one another, and arranged in groups transversely to the length of the ring. By this arrangement it is claimed that secondary currents are avoided, and that the power of the machine is increased by increasing the length of the ring. In the intervals between the groups forming the armature are the spokes B_1 carrying the projections B_3, on to which are fixed the strong brass discs G_1 G_2. One of these discs, G_1, carries a steel ring turning freely round E_1, of which the projecting part, N, turns in the bosh M. The other disc G_2 is fixed on the principal axle H furnished with the pulley I. The disc G_1 is pierced with six openings, the edges of which are bevelled or furnished with wings, Fig. 3, of such a shape that the cylinder in turning works as an air turbine taking in strong currents of air by the openings in G_1, currents which traverse the whole interior length of the cylinder and keep it cool. The external electro-magnet is made with two branches A_1 A_3 united by the bed plate A_2, thus forming a horse-shoe electro-magnet. In order to prevent vibrations the pole pieces are connected at the top by a non-magnetic plate—in the machine exhibited this is of brass—and carried at the bottom by two non-magnetic supports L L. The number of layers of wire used on the electro-magnets are increased towards the poles.

The commutator is made of strips of copper, which by means of the ring J are fixed to the disc G_2, these strips being insulated in the ordinary manner. The current is collected by two or four brushes of the usual kind from the commutator. They are mounted near K and arranged to turn round the axle for regulation; in other words, that they may be put in the best position according to circumstances. The machine can be used either as a self-exciter on the usual principles, or the field magnets can be actuated by a separate exciter.

Electric Light for Naval Purposes.—Experimenst have recently been made in Newport Harbour, Rhode Island, U.S.A., with an electric search light, which is placed in a parabolic reflector, pivoted to turn in any direction, and actuated by a small electric motor. The experiments were successful, and were conducted under the direction of Captain Selfridge, of the United States navy. We also hear that experiments are shortly to be made in our English navy, the object of which is to ascertain the possibility of using reflected light for search purposes, it having been found that with the ordinary apparatus the men in charge are exposed to the fire of the enemy. The experiments will take place on board H.M.S. "Sultan." The detector will be placed below, and the light projected through a tube upon a concave mirror, which will be fixed on the bridge above, or on the mast, if necessary, and which will by means of a pivot arrangement, be able to sweep the water in all directions. The electricity will be generated by a D Gramme machine, and various lenses will be tried.

Incandescent Electric Lamps.—Our excellent contemporary, *La Lumière Electrique*, devotes the whole of its issue of the 1st of October to a description of the various systems of electric light by incandescence. The article, which is from the pen of M. le Comte du Moncel, is accompanied by several excellent illustrations.

* * *

Scene—The Elysian Fields (Paris Version).

Time—Midnight, September, 1881.

[*The Interior of the Electrical Exhibition in the Palais de l'Industrie. Several* Shades of Ancient Electricians *discovered gliding towards the buffet.*]

Thales of Miletus. The infernal uproar is over, the curious throng has gone, and all is quiet again in these celestial bowers, thank the gods. Phew! how close it is. Gentlemen, what will you drink? My throat is as dry as a Leyden jar.

Franklin. I guess I'll take sugar in mine. A "corpse reviver" for me.

Oersted. A bock.

The Rest. Coffee with cognac.

[*They seat themselves at a small table and light cigarettes.*

Thales of Miletus (*in difficulty with his French*). Garrson! Donnez moi a "cadaver resuscitur," et deux bock, et café avec cognac pour all les autres.

Marat (*en garçon*). Pardon, monsieur.

Thales of Miletus. Un "cadaver revivifier," deux bock, et café avec cognac.

Marat. Q'est q'cest un cadaver revivifier?

Franklin. Something hot and strong—le grog chaud.

Marat. Bien monsieur. [*Exit.*

Thales of Miletus. Now, all these wonderful things we see about us, lights, machines, and far-speakers, you say, have sprung from my little toy of 2,000 years ago. I can't believe it!

Ampère. Two thousand years ago you discovered that a piece of amber when rubbed would give out a tiny spark, and attract light bodies—that spark has now grown into these brilliant lamps, which vie with the sun himself.

Thales of Miletus. Wonderful! but here comes the drink (*takes a pull at his bock*). How that beer refreshes one. Phew! My little experiment has grown into these luminous orbs! Well, I never!

Ampère. You are the father of a great science—

Thales of Miletus (*with a smile*). I get the credit of that discovery; but, gentlemen, *entre nous*, I don't mind telling you I had it from young Cleon. Cleon showed me the living electron.

The Rest. Cleon?

Thales of Miletus. But Cleon was a pupil of mine.

The Rest (*reassured*). Oh, that's all right.

Ampère. You are the Father of Electricity.

Thales of Miletus (*winking*). Yes! the step-father. However, let that pass. Somebody must be Father of Electricity, and I flatter myself I make a very respectable one. But my family has grown out of all knowledge. Here we have artificial suns, moons, and stars; machines for travelling swiftly by land, sea, and air; machines for weaving, sewing, pumping, hammering; machines for speaking and singing to the ends of the earth. It is marvellous. I feel as if I were among the demons. Vulcan's workshop is nothing to it.

Franklin. And yet this is only the beginning of the wonders. Your child Electricity has just come of age. This fête is his majority.

Thales of Miletus. How has it all come about?

Franklin. By the working of many minds, some of whom are with us in the shades. But they have gone to different parts thereof. (Hem! that grog *is* strong.) They are not all visible in the Elysian Fields.

Thales of Miletus (*sadly*). I have met but few there.

Franklin. There are still some upon the earth.

Thales of Miletus. I think there must be many. Consider the number and variety of electric lights, the number and variety of far-speakers. Each of these had a creator.

Franklin. Not necessarily. One creates and the rest take out to nurse. There are many adopted children, but the child of adoption is loved just as much as a true son, and everyone thinks his own crow whitest, as they say in Britain, the Isles of the Sea.

Thales of Miletus. That must be so, from the accounts given in the papers I have read.

Franklin. Thales you must not believe *all* you see in the papers.

Thales of Miletus. What! is there not truth in science?

Franklin, Yes! but not always in finance. Science now is no longer philosophy as it was in your day. It is money.

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THALES OF MILETUS. These prodigies, are they not born of the love of truth and fame—the pure desire to do good unto your fellow men?

FRANKLIN. Money first, love of learning afterwards; the pure desire to do good unto yourself.

THALES OF MILETUS. Your ingenious countryman, he who makes the little sheet of metal speak the words of lips which have turned to dust—is he not honoured, did he not work for glory?

FRANKLIN. Perhaps; mais, above all, he is rich. The phonograph likes best to cry out "dollars." It speaks that word very well.

THALES OF MILETUS. But all do not work in that spirit.

FRANKLIN (*hesitating*). No, not all. Our friend Oersted here, and M. Ohm, M. Volta, M. Ampère did not work for gold. [*Pointing to the shade of* FARADAY, *who passes arm in arm with Davy*]. There goes a spirit who did not think and toil for gain. But these are in Elysium.

THALES OF MILETUS. You yourself did not seek money when you probed the clouds for lightning.

FRANKLIN. That's true. I did not patent my kite. But if I lived now I guess I should.

OERSTED. You would be wise in your generation.

FRANKLIN. I could have realised a million dollars easily by that morning's work. There was money in that kite. Yes, sir. That is, if Edison wasn't before me. After all, perhaps, it's lucky I was dead before he was born.

THALES OF MILETUS. No! no! we have lived too soon. The world is just beginning to open its eyes, to wake up to the day. Ah! [*sighs*]. Garsson, donnez moi another bock.

FRANKLIN. For me, I am content to be out of the struggle, but happy to be able to return and look on—a silent member.

THALES OF MILETUS. Perhaps they will be able yet to restore life to the dead by electricity. I see they can cure pains and kill by the electric discharge; they can preserve the flesh in copper, and make metallic mummies. A man can have his ancestors copper-plated and ranged upon a shelf. Why should they not instil life into them?

FRANKLIN. The powers forbid! the world would get too full. Let us be thankful we are out of it before they have electro-plated us—before the mandate "Dust thou art, to copper thou shalt turn" is formulated. [*The clock strikes one.*

THALES OF MILETUS. Hark! 'tis the signal for our return. Eh bien! Garsson, combien? [*They vanish.*

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).

The 16th ordinary general meeting of this Company was held at the offices, 106, Cannon-street, E.C., on the 30th ult., under the presidency of Mr. Neil Bannatyne.

The MANAGER (Mr. Charles Gerhardi) read the notice convening the meeting, and the report of the directors was taken as read. It stated that for the half year ending 30th June last there was a balance to the credit of profit and loss of £7,245. The result of the half year's working may be considered satisfactory, the receipts being in excess of those for any previous half year except that ending 31st December, 1875, when exceptional circumstances caused a large increase of traffic. The Company's cables and land lines continue to work perfectly, the high electrical condition of the submarine cables showing no variation. The advantages anticipated from the removal of our cable station from the Lizard to Falmouth have been fully realised. The entire cost of the construction of the land-line between Falmouth and the Lizard necessary to effect this removal is slightly in excess of the estimate of £2,500. The profit and loss account showed that the receipts for telegrams in the half year had been £9,558.

The CHAIRMAN, in moving the adoption of the report, said that he need scarcely state that the directors met them on that occasion with a degree of satisfaction as to the present position of the company and confidence as to its future prospects much greater than they had been able to entertain for many years. As regarded their present position, the result of the past half year's working enabled them to see their way to recommend to them the payment of the dividend on the preference shares, to add the sum of £2,302 to the reserve fund, increasing it to the respectable sum of £5,500, and to pay a dividend of 3s. per share on the ordinary shares for the half year, free of income tax, being at the rate of 3 1-3rd per cent. per annum. This had been much more satisfactory than they had been able to attain for some years past, and for himself he looked at it with special satisfaction when he saw the considerable sum that they had been able to add to the reserve fund, because he had all along maintained that one of the first things to be considered by the directors of a cable telegraph company was the establishment of a substantial reserve fund. That, in his opinion, was the course pursued by all the large companies who were well managed, and who had got into a satisfactory position, and it was the course which every telegraph company should pursue. It was the only thing which would give the property of the company a stability, and render it independent in the long run of those casualties to which submarine cables were so liable. As regarded their future prospects, he was very happy to be able to tell them that the traffic of the company for the past three months had been highly satisfactory, showing a considerable increase on the corresponing three months of last year. They had no reason to doubt that their traffic would be good for the next three months, and if they had no mishap he thought they would be able to see their way when they met there again to show an amount at the credit of their profit and loss account which would enable them to pay the preference dividend, to add a further sum to the reserve fund, and to offer to the ordinary shareholders a dividend showing a substantial increase on the rate which they would declare that day. As regarded their lines and their working staff, he might say that they were in a position to deal satisfactorily with any additional amount of traffic, which he thought it was only reasonable to expect they might have in consequence of the much improved state of business and of matters generally in Spain and elsewhere. One advantage which would result from their improved position would be that in future they hoped to be able to pay the dividends immediately after the meeting [hear, hear]. Of course, that was the result of their improved financial position, owing to the sum which they had at the credit of their reserve, and which they would be able to use for a month or two for that purpose if they required it. Nothing else occurred to him to mention, but they would be happy to hear any gentleman who might have any questions to ask, and to give them every information.

Mr. LOWE inquired in what securities the reserve fund was invested.

The CHAIRMAN replied that their reserve fund was very often in the items in the accounts.

Mr. LOWE: You carried forward a sum last year. How was that invested?

The CHAIRMAN stated that a length of time elapsed before they received the money they had earned—they were always in advance. The question of how the reserve was invested was a matter of account—they must take the debits and the credits. When at any time their receipts came in before the demands arose they lent the money upon the Stock Exchange on Securities with which they were satisfied, and on which they had an ample margin. They invested the money in this way because they did not know how long they might have it. By and bye, as their position was improving, they would have the money for a long time—in fact, until they were obliged to use it for the repair of one of the cables. They would then discontinue lending the money on the Stock Exchange, and find a permanent investment for it. He was a director in one company which had a reserve of between £40,000 and £50,000. They invested such portion as they thought they might use for that purpose for a year at a time, and received a very good rate of interest, and that was the course which, when this Company was in the same position, they would find it advisable to pursue.

Mr. BEARD pointed out that the view held by the first speaker was that if they had a reserve fund a certain amount ought to be put by on which they could put their hands at any time.

Mr. LOWE said he thought it would be advisable to have it in Colonial or Indian bonds.

Mr. BEARD was very gratified at the position of the Company, but he thought that the reserve fund ought to be where it could be fixed and positive.

Mr. COCHRANE said it struck him that a very large amount of the six months' earnings was out on credit, and he inquired how this happened. Within a few hundred pounds the whole six months' earnings appeared to be owing.

The CHAIRMAN replied that he had often explained that they did not get their receipts from the Spanish Government till some time had elapsed. The Spanish Government, under their convention, were not obliged to pay them the money they received on the Company's account till six months afterwards; but they generally paid within four months. That explained the amount owing to them. They had no reason to complain of the way in which the Spanish Government had dealt with them. On the contrary, they had dealt very fairly with the Company. They generally received the balances considerably within the time they might take, and they had no doubt they would do so in the present instance. Although they said in the report that the dividend warrants would be paid in November, they were not without hopes that they might get them a week before the end of October. They thought it well, however, to mention a date in the report when they could rely on receiving the warrants. With regard to the reserve fund, the Board quite agreed with what had been said. As soon as they had a sufficient sum they would invest it in the way suggested; but meantime a considerable portion of the reserve fund was not in their hands as cash. It was, however, available when anything happened within notice of a week or two.

Mr. COWARD said he had no doubt that the directors would be more gratified than the shareholders at being able to put aside the sum to a fixed reserve, but placed as the company was, it would be crippling their resources if they locked up any sum for twelve months. Looking at the balance sheet, he really thought that the directors were to be congratulated on the report, and that the shareholders should not tie their hands in any way.

Mr. SCOTT (director) then seconded the motion for the adoption of the report, and it was carried unanimously.

The CHAIRMAN next moved the declaration of the full preference dividend, less income tax, and a dividend of 3s. per share on the ordinary shares, free of income tax.

Mr. ETLINGER (director) seconded the motion, and it was carried unanimously.

The CHAIRMAN formally announced that that closed the business, and alluding to the few shareholders present, expressed a hope that it might be taken as a sign that they were satisfied, seeing that they had 123 ordinary and 290 preference shareholders. Mr. Etlinger reminded him to inform them that £2,600 had been expended on a land line, which was a very valuable addition to their system. That money had been taken out of the reserve fund, but there was a balance of the reserve, and it was as much there as if it were in the bank.

Mr. BEARD then moved a vote of thanks to the chairman and directors. He felt quite satisfied that they had done everything they could for the shareholders' interests, and he really thought that there was a good future for the Company.

Mr. LOWE seconded the motion, and it was carried unanimously.

The CHAIRMAN expressed the acknowledgments of the directors. They would continue to watch over the interests of the Company, and do everything they could to merit the confidence of the shareholders in the future. He quite shared in the confidence which had been expressed as regarded their future, as far as it was possible to be confident in a cable company.

The proceedings then terminated.

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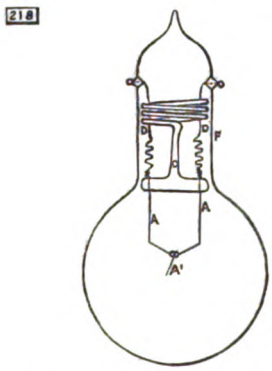
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

218. IMPROVEMENTS IN APPARATUS FOR PRODUCING ELECTRIC LIGHT, *J. E. H. Gordon. 17th January*, 1881. 6*d*.

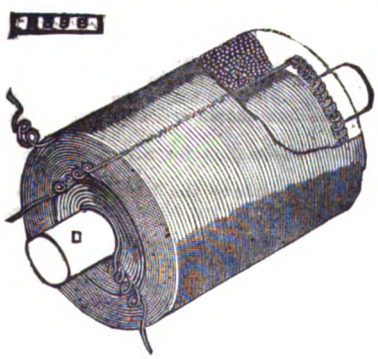
This is an improvement on a former patent, No. 1826, 1880, in which the balls of refractory metal heated by the discharge of high tension alternating currents between them are enclosed in vacuo in a glass globe. The figure shows one form of the lamp. A^1 are the balls of refractory metal on one end of wire stems, A. The opposite ends of the stems are embedded in glass rod C. The rod is formed up over the wires from glass in a soft plastic state, whilst the wires



are held at any required distance apart. A glass stem is formed to project at right angles from C, and terminates in spiral coils. The balls do not meet but overlap. D D are platinum conducting wires, C is inserted into the neck, F, and D D are drawn through perforations on its opposite sides. The neck is contracted above where the wires pass out, and the latter are sealed to its sides by glass applied around them on the outside. The globe is then exhausted and filled with nitrogen or other inert gas, and the globe again partially exhausted, the fine tube leading from it is then sealed and its end broken off.

2398. IMPROVEMENTS IN TELEPHONES, &c., *R. M. and W. van O. Lockwood.*—*31st May*, 1881. 6*d*.

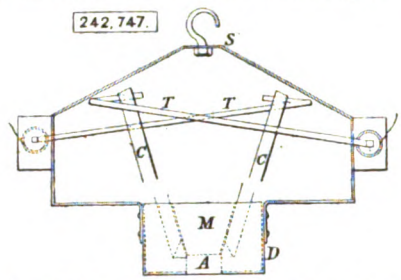
The invention relates to a novel manner of winding the coil, whereby a second wire is got leading from the coil at a point near its centre without breaking the single wire, of uniform size, forming the coil; also to a novel construction of the base or support for the transmitter, the support being of cylindrical form, forming a cylinder surrounding the helix; also a new construction



of the covering of the microphone, and a new arrangement of the helix and microphone relatively to each other, and the support as described. The construction of the coil is shown in the figure. The core D is wound with wire to about one-third the size of the coil, the end of the wire projecting. When the coil is wound so far a second wire is attached thereto by a half connection, and carried out therefrom without breaking the main wire, which is then further wound until the coil is completed, terminating in the outer end. The first wire is connected with the battery, the second wire is connected directly with the transmitter, and the third or end of the main wire with the receiver. The other improvements are also described in the patent.

242,747. ELECTRIC LAMP, *Antoine Bureau, Ghent, Belgium.*—*Filed May 27th*, 1880.

Claim.—In an electric lamp, the combination with two converging electrodes arranged to be fed by gravity, of a block of refractory material provided with converging passages or sockets in which the poles of the electrodes are received and hidden from view, the lower face of the block being cut out like a vault for the light, substantially as set



forth. (2) The combination of carbons C with guide block M, and conducting rods T, turning on centres, substantially as and for the purpose described. (3) The combination of carbons C with guide block M, inclosed in casing D, conducting rods C turning on centres, and suspension frame S, substantially as and for the purpose described.

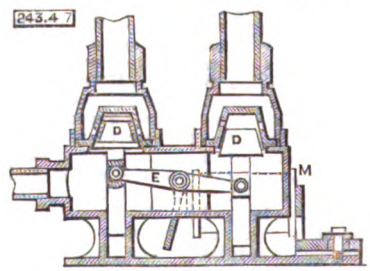
242,896. INCANDESCENT ELECTRIC LAMP, *Thos. A. Edison, Menlo Park, N.J.*—*Filed December 15th*, 1880.

Claim.—(1) The combination, with the incandescing loop of an electric lamp of a support arranged to maintain the carbon loop in its

normal position. (2) The supporting neck in which the wires leading to the loop are sealed, provided with an arm for maintaining the loop in its normal position, substantially as set forth.

243,417. FLUID PRESSURE BRAKE, *George Westinghouse, jun., Pittsburg, Pa.*—*Filed March 31st*, 1881.

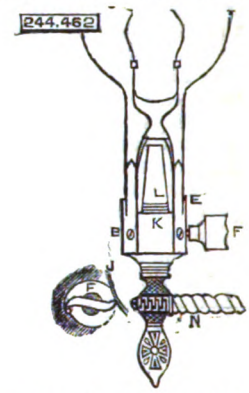
Claim.—(1) A pair of valves arranged in the lines of communication from a power chamber to a brake cylinder, and from the latter to the external air, in combination with an electrical apparatus adapted by the making or breaking of the circuit to shift such valves simultaneously, the one to an open and the other to a closed position, substantially as set forth. The valves D D^1,



arranged on the opposite arms of a lever E, pivotted on a rock shaft, in combination with armatures E^1 and electro-magnets M, substantially as set forth. (3) In combination with auxiliary reservoir R^1 and compressing apparatus for keeping the same continuously charged with fluid pressure, a brake cylinder C and an interposed electrically-operated valvular apparatus adapted to apply and release the brake power by breaking and restoring the electric circuit, substantially as set forth.

244,462. ELECTRIC LAMP HOLDER, *Otto Kartzmark, New York, N.Y., assignor to the United States Electric Lighting Company, same place.*—*Filed March 8th*, 1881.

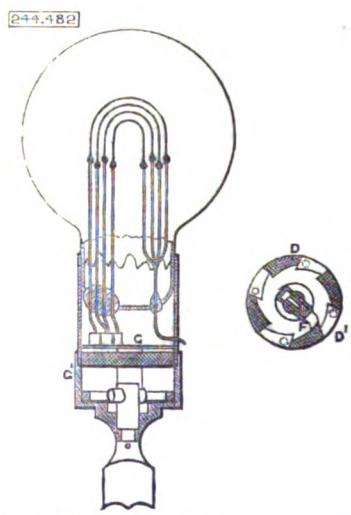
Claim.—(1) A combined gas burner and electric lamp supporting base or socket adapted for attachment to and use with a gas pipe or bracket. (2) The combination of a gas burner, an insulating electric lamp vase or socket, and an electric circuit breaker with conductors, as described, these parts being connected together and arranged for attachment to and use with a gas pipe or bracket. (3) In a combined electric lamp holder and gas burner, a perforated insulating base or socket for an electric lamp, forming a prolongation of the gas pipe, in combination with a burner or tube and metallic connections, leading from the line wires, adapted to be put in connection with the terminals of an electric lamp, whereby either the gas or an electric lamp may be employed as the source of light, as set forth. (4) The combination of gas pipe, N, electric lamp base, K, forming a prolongation thereof, and provided with a burner, L, and conducting plates,



B E, and an incandescent electric lamp adapted to fit down over the burner and complete the circuit between the contact plates, as and for the purpose set forth. (5) The combination, in an electric lamp base or socket for use with a metallic bracket, of the insulated cylindrical block K, plates B E, metallic nut I, inserted in the block K, and a switch, F, with conducting strip, H, for making and breaking the circuit between the plates and the nut, as shown. (6) In an electric circuit breaker, a rotary shaft, F, and pin, G, passing freely at right angles through the same, in combination with a spring, J, and contact strip, H, constructed as described, these parts being arranged for operation, and contained within an inclosing case or recess of insulating material, substantially as hereinbefore set forth.

244,482 ELECTRIC LAMP, *Charles D. Perkins, New York, N.Y., assignor to the United States Electric Lighting Company, same place.*—*Filed February 24th*, 1881.

Claim.—(1) The combination, with the exhausted globe of an electric lamp, of two or more independent incandescing conductors of unequal degrees of electrical resistance sealed therein, whereby as many intensities of light may be obtained from a given current as there are conductors, as described. (2) A multiple circuit



breaker for electric incandescent lamps, consisting of a spring seated contact pawl, F, fixed to a rotary shaft and adapted to engage with the alternate metallic and insulating segments D D^1, substantially as shown and described. (3) The combination, in an incandescent lamp base, of metallic segments D, pins g^1, and connecting strips G, provided with sockets for the reception of the free ends of the conductors, substantially as shown.

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TELEGRAPH SHARE LIST.

Companies.	Closing Prices Oct. 5.		Business Done Week Ending Oct. 5. Highest.	Lowest.
Anglo-American	53½,	4	53¾	52¾
Do. Deferred	82½,	3½	83½	83
Do. Preferred	24½,	¼	24½	24½
Brazil Submarine	11,	¼	11½	10¾
Cuba	9½,	10	10	9 13-16
Do. Preference	16,	17	—	—
Direct Spanish	5,	⅛	—	—
Do. Preference	14½,	15½	—	—
Direct United States Cable	10¾,	¼	10¾	10¾
Eastern Telegraph	10⅛,	⅛	10⅛	10⅛
Do. 6 per Cent. Preference	13,	¼	13½	13½
Do. 5 per Cent. Debentures, 1899	105,	8	—	—
Eastern Extension	11⅛,	⅛	11⅛	11
German Union	10½,	¼	—	—
Globe Telegraph and Trust Company	6½,	¼	6½	6 9-16
Do. Preference	12½,	¼	12½	12½
Great Northern	12½,	¼	12½	12½
Indo-European	28,	29	—	—
Mediterranean Extension	2⅛,	3	2 15-16	2 15-16
Do. Preference	9¼,	¼	9¼	9¼
Reuter's	12,	13	12½	12
Submarine	280,	90	—	—
West India and Panama	1½,	2½	2½	1 11-16
Do. 1st Preference	7¼,	¼	7¼	7¼
Western Brazilian	7⅛,	⅛	7 11-16	7⅛
West. Union 7 per Cent. 1st Mortgage	125,	30	—	—
Do. 6 per Cent. Sterling Bonds	104,	107	—	—

TRAFFIC RECEIPTS FOR SEPTEMBER, 1881.

Companies.	Sept., 1881.	Sept., 1880.	Increase.	Decrease.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	£2,000	£1,710	£290	
Direct Spanish Telegraph Company	1,790	1,537	253	—
Direct United States Cable Company	—	—	—	—
Eastern Extension Telegraph Company	30,866	28,771	2,095	—
Eastern Telegraph Company	47,407	41,717	5,690	—
Great Northern Telegraph Company	22,280	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—

HAMMOND and Co., 110, CANNON STREET, LONDON,
Agents and Concessionaires of the "Brush" Electric Light for Lancashire and the North of England, are prepared to give TENDERS for ERECTING ELECTRIC LIGHTS in either private or public buildings.

VULCANITE.
HARBURG INDIA-RUBBER COMB COMPANY.
LONDON WAREHOUSE: F. WINTER.
138, LONDON WALL, WOOD ST., E.C.
EBONITE.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.
Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.
NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

CITY and GUILDS of LONDON INSTITUTE,
For the Advancement of
TECHNICAL EDUCATION.

WINTER COURSES of LECTURES, Laboratory and Workshop Instruction, at the Temporary Class Rooms of the Institute, Cowper-street, Finsbury,
COMMENCING OCTOBER 4, 1881.

TECHNICAL CHEMISTRY.—H. E. ARMSTRONG, Ph.D., F.R.S., Professor.
EVENING COURSES.
Distilling (Coal Tar and Spirit) ..... Mondays.
Fuel and Illuminating Agents ..... Fridays.
Metals and Metallic Compounds ..... Mondays.
DAY CLASSES (Preliminary).
Lectures ..... Wednesdays and Fridays.
Laboratory ..... Tuesdays.

TECHNICAL PHYSICS.—W. E. AYRTON, F.R.S., Professor.
EVENING COURSES.
Electric Lighting and Transmission of Power ..... Wednesdays.
Electrical Instrument Making ..... Mondays.
Electrical Laboratory Apparatus ..... Fridays.
DAY CLASSES (Preliminary).
Lectures ..... Tuesdays and Thursdays.
Laboratory ..... Thursdays.
Fees 3s. 6d., 5s., and 7s. 6d., for Lectures and Laboratory Courses together.

TRADE CLASSES (transferred from the Artisans' Institute).
Metal Plate Work and Pattern Cutting ..... Tuesday and Thursday Evenings.
Bricklaying ..... Monday Evenings.
Carpentry and Joinery ..... Tuesday and Friday Evenings.
Stonemasonry ..... Wednesday and Friday Evenings.
Builders' Work, including Sanitary Engineering ..... Thursday Evenings.
House Decoration ..... Wednesday Evenings.
Modelling in Wax, Clay, &c. ..... Monday and Thursday Evenings.
Fees for the Session of about eight months, 6s. and 10s. 6d.

Apprentices admitted to these Trade Classes at a registration fee of 2s.

Further particulars with respect to any of these Courses can be obtained on application at the Schools, or from the Director and Secretary of the Institute, Gresham College, London, E.C.
PHILIP MAGNUS,
Director and Secretary.

CITY and GUILDS of LONDON INSTITUTE.
TECHNOLOGICAL EXAMINATIONS.

The next EXAMINATIONS in TECHNOLOGY will be held at the different Provincial Centres throughout the Kingdom on the evening of May 24, 1882.
Teachers desiring to form classes should apply at once to the Director and Secretary of the Institute.
List of subjects in which the examinations will be held and general conditions of payment on results, can be obtained by application to the
Central Office, Gresham College, London, E.C.
PHILIP MAGNUS,
Director and Secretary.

KING'S COLLEGE, LONDON.—EVENING CLASSES IN ELECTRICITY AND ITS VARIOUS APPLICATIONS.—These classes, which are held on Wednesday evenings, from 7 to 8, under the direction of R. E. DAY, M.A., Author of "Exercises in Electrical Measurement," &c., will OPEN on WEDNESDAY, October 12th, at 7 p.m.
The instruction will be specially adapted to meet the requirements of students who are preparing for the Prel. Sc. and First B.Sc. Examinations at the University of London.
The fee for the course, from October to Easter, is £1 11s. 6d., payable in advance in the College office.

TO ELECTRICAL ENGINEERS and EXPERIMENTALISTS.—WATCHES which CANNOT be "MAGNETISED," as exhibited at the Electrical Exhibition, Paris.
E. DENT and Co. (makers of the standard clock of the Royal Observatory, Greenwich), 61, Strand, and 34, Royal Exchange, London (only addresses).
N.B.—Watches can be converted to this plan.

THE SCHOOL OF
SUBMARINE TELEGRAPHY & OF TELEPHONY.
ESTABLISHED IN 1868.
4, GEORGE STREET, HANOVER SQUARE, LONDON, W.
MANAGING DIRECTOR: Mr. T. J. JONES, M.S.T.E.

The course of Practical and Theoretical Instruction in the higher branches of Overland and Submarine Telegraphy embraces, in addition to the manipulation of the various systems of working in general use, the following subjects:—
MATHEMATICS, MECHANICS, and CHEMISTRY, } In relation to Telegraphy.
SIGNALLING and TESTING INSTRUMENTS.
ENGINEERING FORMULÆ and their Application in Practice.
ELECTRO-STATICS.
ELECTRO-DYNAMICS.
MAGNETISM.
METHODS of TESTING the ELECTRICAL CONDITION of a LINE During and After its Construction.
TESTING FOR and LOCALISING FAULTS, &c., &c., &c.
The instruction, both in signalling and testing, is of a thoroughly practical character, as the classes work with the actual instruments used on long lines, through cables of various lengths, from 600 to 3,000 knots, so that the signals of the Eastern, Atlantic, and Brazilian Co.'s, &c., are exactly reproduced, and the pupils fitted for any line.
A Course of Instruction in the Fitting up, working, and Testing of TELEPHONE CIRCUITS has now been added to, and embodied in, the ordinary curriculum, including all the forms of TELEPHONES, the various switch board arrangements and EXCHANGE SYSTEMS in general use.
Further information can be obtained on application to the SECRETARY.

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ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians,
86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.
Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

NEWTON'S PATENT LAW and PRACTICE, Price 2s. 6d.
This standard work contains all legal and other information necessary for intending patentees, including Government charges, agency fees, and rules of the Commissioners of Patents.
TRUBNER and Co., Ludgate-hill, and may be obtained at the Office for Patents, 66, Chancery-lane, W.C.

THE ELECTRIC LIGHT and POWER GENERATOR COMPANY (Limited).—WANTED, for the post of GENERAL MANAGER, a thorough business man, well acquainted with the practical application of electricity to lighting purposes. A liberal salary will be given, and none but gentlemen with the above-mentioned qualifications need apply. Applications, with copies of testimonials to be addressed, by letter only, to the Secretary, 29, Bankside, S.E.

DUNCAN WALLET & CO.,
BONDED STORE AND PROVISION MERCHANTS,
15, BILLITER STREET, LONDON.

Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

JOHNSON'S PATENT TRANSMITTER,
IN COMBINATION WITH
BELL'S EBONITE TELEPHONE.

Unequalled for Telephone Exchange or Private purposes.

ALL ROYALTIES PAID.

TASKER, SONS & CO.,
ELECTRIC AND TELEPHONIC ENGINEERS,
SHEFFIELD.

ELECTRIC LIGHT.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

HARBOROW & CO.,
ELECTRIC LIGHT ENGINEERS
AND
TELEGRAPH INSTRUMENT MANUFACTURERS,
4, CIRCUS STREET, LONDON, W.

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

Southampton-buildings, Chancery-lane

NEWALL'S PATENT LIGHTNING CONDUCTORS.

Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

SOLE PATENTEES OF UNTWISTED WIRE ROPE.

Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c.

Gilt and Silver Cord for Hanging Pictures. Iron, Steel, and Copper Cord for Clock and Sash Lines, &c.

R. S. NEWALL & CO., LONDON, 130, STRAND, W.C.

LIVERPOOL—36, Waterloo Road. GLASGOW—68, Anderston Quay. Manufactory—GATESHEAD-ON-TYNE.

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SLIP

ELECTRICAL EXHIBITION.—It is rumoured that the awards will be made on the 20th inst.

THE TELEPHONE IN MELBOURNE.—It is stated that telephonic communication between the Government offices has been completed.

READING SCIENCE AND ART SCHOOLS.—On Monday last the prizes gained by the students of these schools were distributed by Sir J. Anderson.

REDUCTION IN TARIFF.—It is stated that the French Government are negotiating for a reduction of the telegraph tariff between England and France to 20 centimes per word.

INVERNESS AND THE ELECTRIC LIGHT.—It is said that the electric light will occupy a prominent position as an illuminant on the occasion of the opening of the new Town Hall.

REUTER'S TELEGRAPH COMPANY.—The directors of this company have declared the usual interim dividend at the rate of 5 per cent. per annum, free of income-tax, for the half-year ending June 30 last.

A DUNDEE ELECTRIC LIGHTING COMPANY.—At a meeting held in Dundee on the 5th inst. it was resolved to form a company to be called the Northern Electric Light, Power, and Appliance Company (Limited).

DIRECT UNITED STATES CABLE COMPANY.—The interest due on the 15th inst. on the Six per Cent. Debenture Loan of this company will be paid on and after that date at the Consolidated Bank, Threadneedle-street.

ACCIDENT BY LIGHTNING.—On the 21st of September, during a severe thunderstorm at Verdun, in France, four out of a troop of soldiers on the march were struck by lightning, one of whom was killed, and the other three badly hurt.

THE TELEPHONE IN THE PROVINCES.—At a recent meeting of the Brierley Hill (Staffordshire) Local Board permission was granted to the National Telephone Company to erect poles and wires in one of the streets of that town.

ELECTRIC LIGHT FOR MINES.—The Government Commission on Mines have been at the Electrical Exhibition in Paris, the object of their visit being, we believe, to see how far the electric light may be used with safety in fiery mines.

LIGHTNING CONDUCTORS IN JAPAN.—It is said that lightning conductors are being adopted in Japan, and that two have been fixed to the residence of the German Legation in Tokio, the work having been carried out by a Japanese engineer.

ELECTRICITY IN HOUSE BUILDING.—*La Lumière Electrique* says that the municipal authorities of several towns in France have sent their architects to the Paris exhibition to report on the apparatus more particularly suited to municipal requirements.

THE EASTERN EXTENSION COMPANY.—The next ordinary meeting of this Company will be held on Wednesday, the 19th inst. We understand that the ss. "Seine" has already sailed to lay the cable referred to in the report which will be found in another column.

"THE TELEPHONE."—A new "Telephone" is announced as the "smartest thing going," and as being able to "transmit the future voice of the nation." On closer inquiry we find that all this refers to a new evening paper of that name, not to a new telephone.

ELECTRIC LIGHT AND POWER-GENERATOR COMPANY.—It is stated that this company has acquired the exclusive use of the Maxim incandescent and the Weston arc systems of electric lights for the United Kingdom, India, and all British colonies and dependencies excepting Canada.

COUPONS.—The coupons of the Submarine Cables Trust, due on the 15th inst., will be paid on and after that date, between the hours of 10 a.m., and 2 p.m., by Messrs. Glyn, Mills and Co., of 67, Lombard-street, E.C., with whom the coupons must be left three days previous to payment.

ELECTRIC LIGHT IN SHEFFIELD.—We hear that Messrs. Tasker, Sons, and Co., engineers and electricians, Sheffield, are arranging with several firms for illuminating their premises with the electric light. A successful experiment was made with their own premises in Station-road recently.

ELECTRIC LIGHT IN JAPAN.—We hear that the question of electric lighting is occupying the attention of the Japanese, who are thinking of illuminating by this means some of their principal towns. The new theatre which is shortly to be built at Yokohama will be lit by means of electricity.

PRESIDENT GARFIELD.—It is stated that during the time the President of the United States lay ill at Longbranch an average of 100,000 words of Press matter were transmitted per day by the Western Union Telegraph Company, and that on the day of his death the number of words transmitted for the Press amounted to 225,000.

LONDON INSTITUTION.—Among the papers on subjects connected with electricity and magnetism which are down for reading at this Institution during the coming session we notice the following, viz.:—"Electricity *versus* Smoke," by Dr. Lodge, on the 15th of December; "The Storage of Power," by Professor Ayrton, on the 2nd of March.

ELECTRIC LIGHT AT THE GRAND OPERA, PARIS.—It is stated that four special representations of opera and ballet are to be given at the Grand Opera in Paris, at which the entire house, including the stage, will be illuminated by the electric light. M. Jules Cohen has composed for the occasion a cantata commencing with the words "Terre, éclaire-toi!"

LIGHTING OF THE SAVOY THEATRE.—This new theatre, close to the Thames Embankment, was opened on Monday night last, when some parts of the structure was illuminated by means of electric light. The arrangements were necessarily tentative, and improvements will doubtless be introduced; but on the whole they are spoken of approvingly by the daily press.

PRICES.—The prices as quoted this week are:—For gutta percha per lb.:—Good to fine, 2s. to 4s.; low to medium, 3d. to 1s. 9d. India rubber, fine Para, 3s. 3½d. to 3s. 4d.; negrohead, 1s. 11½d. to 2s.; central American, 1s. 6d. to 2s. 2½d. Assam and Pegu, 8d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 5d. to 2s. 2d.

THE CROMPTON LIGHT.—The highly-appreciated and satisfactory electric light arrangements at Leeds during the late visit of the Prime Minister were carried out by Mr. R E. Crompton. We understand that Mr. Crompton is hastening forward the installation of the electric light in the ss. "Cotopaxi," the vessel sailing at an earlier date than was originally anticipated.

MAGRINI.—In the Italian section of the Paris Exhibition is an electro-magnetic telegraph, dated 1837, by M. Magrini. The apparatus will be described and illustrated in due course, but in the meantime we should be glad of any information relating to Magrini or to his apparatus, which is undoubtedly superior to anything England, or, so far as we know, any other country could show at that time.

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TELEGRAPH STAMPS.—It is understood that the Postmaster-General has decided that the existing distinction between telegraph and postage stamps shall be abolished. New stamps, from £5 downwards in value, available for postal, telegraphic, and receipt purposes, are to be issued, and arrangements are being made to carry out this plan, which, it is expected, will come into operation early next year.

PREFERENCE OF LIGHTNING FOR PARTICULAR SPOTS.—According to a San Francisco paper there is a tract of country in Butte County, Cal., about fifteen miles long by half a mile in width, where lightning strikes trees nearly every time a storm passes over. Beyond this area there is no such damage. The line can be plainly traced by dead timber. As many as three fires have been caused by lightning in this tract in one single storm.

THE ORKNEY AND SHETLAND TELEGRAPH CABLES.—The "Dacia," which has now been engaged for some time in the work of repairing and renewing the Orkney and Shetland cables, has returned to Lerwick after recovering the second one. The weather is very stormy, and fears are entertained that it may be months before the cable can be again laid. On a former occasion a steamer lay for months in the islands without a single day on which these stormy seas could be crossed.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The accounts of this company, subject to audit, show a profit sufficient to enable the directors to recommend a final dividend of 3s. per share, making, with previous distributions, a total of 6 per cent. for the year, besides a bonus of 2s. The entire payment for the past year is 7 per cent., leaving a balance of £54,510, of which £50,000 has been placed to the reserve fund, increasing it to £345,349, and £4,510 17s. 6d. carried forward.

MAGNETS.—M. Pictet finds that the increase of magnetic power in a magnet through the mere presence of the armature in contact is a certain fact for some qualities of steel, but not for all. The first magnetic passes develop nearly the whole of the remanent magnetism in all artificial magnets. Detachment of the armature by the dynamometer seemed to have no action on the magnetic power, only the slipping of the armature when near rupture must be avoided. *Archives des Sciences.*

ELECTRIC LIGHTING.—The erection of the Brush lights at Chesterfield was completed by Messrs. Hammond and Co., the contractors, within one week from the date of the order. The same firm erected sixty-four lamps for the jubilee at Middlesbrough in three weeks. Messrs. Hammond and Co. have further contracts on hand to light the steel mills of Messrs. Steel, Tozer, and Hampton, at Rotherham, and the shipbuilding works of Messrs. A. Leslie and Co., of Hebburn, and Messrs. J. Redhead and Co., of South Shields.

VISIT TO FELTEN AND GUILLEAUME'S WORKS.—The Chinese Ambassador, Mr. Li-Fong-Pao, and suite, on their return from the Hague, on Monday, the 3rd inst., inspected the extensive wire, wire rope, and telegraph cable works of Messrs. Felten and Guilleaume, at Carlswerk, Mülheim-on-the Rhine (and 101, Leadenhall-street, London), this firm having supplied the galvanised wire for the Chinkiang Tientsin telegraph line, as well as the wire rigging and hawsers for the Chinese men of war which are now being built in Germany.

GOOD WORK.—In connection with the jubilee meeting of the British Association the telegraphic capacity of the York Post Office has been considerably taxed, as will be perceived when it is stated that newspaper reports have during the meeting passed through the wires to the extent of 329,268 words, or about 164 newspaper columns of scientific literary matter. This has been accomplished by the aid of five Wheatstone automatic machines, and the efficient manner in which the work has been performed has been such that there was a total absence of complaint.

UNDERGROUND WIRES IN FRANCE.—The laying of the underground cables between Paris and Marseilles is actively proceeding, and has, we believe, got as far as Fontainebleau. The trenches for receiving the iron pipes in which the cables are laid are 1·20 metres deep; there are three conducting cables, with seven conductors in each, giving twenty-one conductors altogether. Facilities for examining and repairing the cable will be provided at every 500 metres distance. The work is not all plain sailing, as forests have to be cut through, and from time to time large rocks, which cannot be removed in any other way, necessitate blasting operations.

ELECTRIC LIGHT IN INDIA.—Allahabad is to be lighted with gas, but as a preliminary measure kerosine is to be burnt in the "cast-iron lamp-posts with supplemental brackets" that are to adorn the town. The proposal has not met with the approval of all the inhabitants, one of whom writes to the *Pioneer*, suggesting that the electric light should be substituted for the other plans. The Municipality of Umritsur have been considering the question, and have decided, as it is very likely lighting by electricity will be sooner or later universally adopted, to communicate with the electric light companies of Bombay and Calcutta.—*Colonies and India.*

THE GLASGOW CORPORATION AND THE ELECTRIC LIGHT.—The Glasgow Corporation, at a recent meeting, authorised the gas committee "to make application to Parliament for a modification of the obligation contained in the Gas Act of 1869, as to the illuminating power of the gas; to vest the corporation with the exclusive right and privilege of manufacturing and supplying electric light to the inhabitants of the city and suburbs if it should hereafter be deemed expedient to adopt this system, with power to construct and maintain engines, and all other necessary works and apparatus in connection therewith; and also to make such experiments in electric lighting as they may think proper."

ELECTRIC LIGHTING STATIONS.—Under this head Mr. C. C. Ruthrauf writes to *The Times* of Thursday last stating his surprise that "neither in England nor on the Continent have there been established as yet general lighting stations to supply electric light after the manner of gasworks, while in America no considerable city is without such an institution." Mr. Ruthrauf, who writes from the American Exchange, Strand, and whom we consequently take to be an American, then gives a brief account of the various methods of lighting in vogue in the cities which have adopted the electric light the details of which, having been given in our columns from time to time, are familiar to readers of *The Electrician.*

THE ELECTRIC LIGHT FROM A MEDICAL STANDPOINT.—Some improvements will doubtless soon be made in the mode of diffusing the light, which is at present far too concentrated and glaring; opal shades appear to absorb too much of the light; but glass globes might be made tinted of a light rose or yellow colour, which would abolish the ghastly and unpleasant light of which every one now complains. Exposure to the electric light is probably not so dangerous for the eyes as was at one time supposed, since only one case has come to our knowledge in which serious results, such as inflammation of the optic nerve, followed exposure to it, and in that in-

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stance the lad was engaged in experimenting with it for several hours, and was much exposed to its influence.—*The Lancet.*

A Photophone without a Battery.—According to the *Naturforscher*, Herr Kabischer has produced sounds by means of selenium and a telephone, but without a battery in circuit. The rays were interrupted by the ordinary disc pierced with holes, and the loudness of the sound was found to rise with increased celerity of rotation of the disc. By permitting solar light to fall directly on a selenium apparatus connected with a galvanometer, a deviation of the needle was noticed. The intervention of pieces of coloured glass modified the effect, excepting those coloured yellow and light brown, but a plate of alum produced no difference. In *The Electrician*, vol VI., No. 25, p. 330 will be found a description of a cell constructed by Professor Blyth, with which he obtained somewhat similar results. His cell was, however, constructed of amorphous phosphorus.

A Medical Hydro-telephone.—A medical hydro-telephone, contrived by Professor Sabatucci (*Riv. Sci. Ind.*) is of the following nature:—Two lead cylinders (5ctm. in diameter and $\frac{1}{2}$ctm. thick) are closed each with two very fine iron laminæ. To the anterior part of each is fitted a wooden mouthpiece (like that of a Bell telephone) connected to a caoutchouc tube, through which one may hear at a distance. The posterior part has a very sensitive electro-magnet communicating with a microphone and battery. One tube is applied to either ear. Words or sounds produced before the microphone, and heard but faintly, are rendered intense and distinct by introducing liquid into the cylinders (the less dense the liquid the better). Two sounds may be compared, and their intensity exactly measured, by varying the quantity of the liquid and noting the effects through the tubes. Various applications of the apparatus, in clinical medicine especially, are looked for.—*Nature.*

The Electric Light in Italy.—Mr. J. Shepherd, of Milan, who was the first to introduce the Brush system of electric lighting into Italy, has been deputed to attend the International Electrical Exhibition by the Chamber of Commerce of Milan in order to study and report on the various systems of electric lighting and applications of electricity to industrial purposes. Mr. Shepherd has also been delegated by the Socićta d'Incoraggiamento per le Arti e Mestieri of Milan to obtain the necessary material (machines and lamps) for a new series of lectures on the electric light to be given during the winter. It was this gentleman who erected the electric lights on Milan Cathedral at the opening of the National Industrial Exhibition some weeks ago, and in the arena, a large amphitheatre which was arranged for the production of grand ballets and other open air amusements. There were fourteen large and sixteen small lights used altogether, and the effect is said to have been very pretty.

Type Printers.—In our description of an apparatus of this kind in our last issue we were unintentionally led into error. We understand that in America not one single instrument of the type described is in use. One American Company has 2,481 instruments in use, of which 1,187 are similar to those used in England by the Exchange Telegraph Company, and similarly with the other instruments in use in America. Then again, the speed of working is stated upon good authority to be inferior and not superior to such instruments as those so extensively used by the Americans, and that the instrument referred to is by no means the only one which is worked on the one wire system. The information given in our article was obtained from, as we thought, the best source, viz., the owners of the apparatus—from, in fact, their own description of it; but the facts and figures we have seen coming direct from the American Company, relating, for example, to the instruments used there, proves that the statements made as to the extensive use and capability of this special apparatus are, to say the least, a little overdrawn.

Professor Blyth on the Electric Light.—Professor Blyth, M.A., F.R.S.E., in his opening course lecture on Natural Philosophy, at Anderson's College, Glasgow, remarked that the problem of electric lighting seemed to be the problem of the day, and referred to the truly glorious electric lights which are at present to be seen in the Paris Exhibition. He stated that to any one who had seen those lights the problem *seemed* to be completely solved, but he thought we might be mistaken. Dim though a gas-flame might be beside its electric rival, lighting by coal gas was far too good a thing to be speedily snuffed out, as we were apt to imagine. No one, he said, could dispute the beauty and efficiency of such lamps as that of Mr. Swan, but before the electric light could become general in our streets and houses, an entirely new method of subdividing it must be discovered; or, what appeared to Professor Blyth to be more probable, electrical accumulators had to become so efficient and so cheap that each house occupier could have his own store of electricity replenished daily from a central source, in order to give him his light by night.

The Russian Telegraph System.—In his "Report on the Trade and Commerce of Kertch for 1880" Vice-Consul Colledge makes the following remarks on telegraphs:—"The Indo-European Telegraph Company have removed their chief station to Odessa, where, in addition to their Indian work, they are working the Constantinople cable. In this day of progress there is great room for improvement in the Russian telegraph system, as messages when received are so mutilated in transmission, and the delay so great, that commercial houses suffer considerably. Merchants cannot receive a telegram from England in reply under 24 hours. I think, as Russia proved herself so anxious in the first instance in giving every facility and pushing on the negotiations for the present Indo-European line on to India, and as her permanent benefits would not suffer, but her revenue would increase by using the English wires, which run direct through Berlin and Emden to London, to receive and transmit all messages to and from Southern Russia to England, an increase in traffic would ensue, the time occupied for each message would not exceed 15 minutes. There is a strong feeling on this subject among the commercial community, and I believe, with a little pressure, the Russian Government are inclined to afford this great boon to commerce."

The Catalogue of the Electrical Exhibition.—We take the following from *La Lumière Electrique*:—"We are somewhat astonished to find the following paragraph in that part of the catalogue of the Electrical Exhibition referring to Mr. Edison's exhibits, showing as it does no little lack of knowledge of the history of science. 'Mr. Edison was the first to take advantage of the peculiar property of carbon to vary the resistance of a telegraphic circuit, and before anyone had approached the question he had already employed this material in the construction of a great variety of scientific and practical instruments, amongst which are the microtasimeter, the telegraph relay and carbon rheostat' (see catalogue p. 178). The truth is," says our contemporary, "that M. du Moncel in 1856, discovered the variation of resistance in a circuit, completed by an interrupter, caused

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by greater or less pressure exerted on the contact pieces of this interrupter; that in 1865 M. Clérac made a carbon rheostat based on this property, which is now in use; and that about the same time M. Elsasser employed the same means to gauge different resistance coils used for telegraphic purposes. All that M. Edison has done is to apply this principle to telephones and to his microtasimeter. Those that wish to credit him with the discovery of the principle are ill advised, and are acting against his interests, for the saying runs, 'He who would prove too much proves nothing.'"

Electricity and Fire Brigades.—Some experiments lately made in St. Petersburg point to a new application of electricity, which, with the increasing multiplication of wires for the electric light, &c., may be found practically advantageous. The conducting wire for electric illumination of a certain café concert garden was prolonged to a steamboat pier on the Neva, and the current there made to actuate a dynamo electric machine, which, in its turn, worked two pumps. One pump was for raising water into a fire-engine cistern; in ten seconds it could fill a cistern of 50 hectolitres, or give 800 to 1,800 hectolitres of water in an hour. The other was a force pump, giving 400 to 800 hectolitres of water in an hour, in a powerful jet. Though the dynamos were not worked to their maximum effect, there was an evident gain, an apparatus contained in a case which measured only about one cubic metre furnishing the same amount of water as the strongest steam pumps. By simply turning the handle of a commutator, the circuit was closed for the actuating current. It is suggested that there should be a central generator of electricity, furnishing a current at any time in case of fire, as well as for lighting purposes; and facilities should be given to connect promptly the conveyed machine with the conducting circuit. In buildings now lit with the electric light the current might be easily utilised in case of fire. These Russian experiments further indicate the utility of an extensive distribution of electricity in cities.—*Times*.

International Electrical Exhibition.—The Jury.—In order to facilitate the labours of the jury, the exhibits have been split up into groups of similar apparatus. These groups are five in number. The first embraces everything connected with the electric light and motive power, and comprises Classes 3, 8, 9, and 14 in the catalogue. The second comprises telegraphic and signalling apparatus, and includes Classes 4, 6, and 7 of the catalogue. The third takes in batteries and everything relating to electro-chemistry and electricity in its relation to medicine, thus embracing Classes 2, 10, and 11 in the catalogue. The fourth group relates to measuring instruments and static electricity, including, therefore, Classes 1 and 5 in the catalogue. The fifth group includes instruments of precision, electrical horology, and electrical apparatus used in industrial occupations, in the navy, the army, and in public works, these being Classes 12 and 13 of the catalogue. The number of jurors told off to each group is as follows:—1. In which there are 399 exhibitors, has 53 jurors, of whom 26 are foreign, and 27 French; 2, in which there are 430 exhibitors, has 38 jurors, 19 foreign and 19 French; group 3, in which there are 238 exhibitors, has 21 jurors, of whom 10 are foreign and 11 French; group 4, with 86 exhibitors, has 16 jurors, 8 French and 8 foreign; group 5, in which there are 353 exhibitors, has 20 jurors, 10 foreign and 10 French. Each of these groups is split up into sections, the further to facilitate the labours of the jury. It is reported that the awards will be distributed on the 20th of this month. The jury are now actively engaged in their labours.

South African Telegraphs.—The life of a telegraph line in South Africa is dependent on various circumstances which have not to be taken into consideration in this country. In many cases, owing to the line having been established during the dry weather, the posts for carrying the wires were planted at so shallow a depth, sometimes under two feet, that the rains of the wet season easily washed them away. The ravages of wild animals have also to be dreaded; and last year great destruction was caused by the rebel Pondomise under Umhlonhlo, on the line between Umtata and Kokstadt, when Mr. Cusens, the telegraphist at Qumbu, very nearly fell a victim to the violence of the rebels. Not satisfied with destroying the telegraph instruments and breaking down the wires, Umhlohnhlo gave directions that every warrior should carry on his person "a piece of Government," and the people not only made armlets for their own use from pieces of the wire, but adorned their noses with necklets from it. Mr. Sivewright, the general manager, in his report, says:—"So far as I am aware, this action of the Pondomise is the first instance of anything like a wholesale destruction of a telegraph line by any of the uncivilised races of Africa. The credulity of the native, who attributed everything not easy of explanation to 'the witch,' combined with the incredulity of the minority who laughed the telegraph to scorn altogether as 'the white man's fetish,' has hitherto preserved the wire intact. But, in the maintenance of telegraph lines, amongst the south and south-eastern African tribes at least, a new era has thus been inaugurated; and in facing any future rising amongst the native races, the destruction of the telegraph lines passing through the rebellious districts would certainly have to be provided against."

Theory and Fact.—Mr. George Anderson, writing to the *Review of Gas and Water Engineering*, says:—"A good practical experiment, however, would be to drive an electrical machine by a gas engine, note the amount of gas used, then burn a similar quantity of gas, and note the amount of light produced from each. Such an experiment would be easily made, and even with the defective burners now to be had, I judge that the gas burnt direct would give more light than the electricity produced by a similar quantity of gas." Our readers will recollect that Mr. Swan has made this very experiment, and that the result was favourable to the gas employed for producing the electric light. His exact words were (*The Electrician*, October 30, 1880):—"One thing is quite clear, that electric lighting by incandescence is an economical process—it will be less costly than gas lighting. That is conclusively demonstrated by the fact that the 1,000 feet of gas employed in working a gas engine to develop an electric current and used in my lamps will yield more light than 1,000 feet of gas consumed in the ordinary way in gas burners. This room is now lighted by twenty of my electric lamps, and to produce the current which feeds them 160 cubic feet of gas per hour are burnt in a gas engine; before my lamps were kindled the room was lighted by 70 gas jets, consuming, I am told on good authority, 280 feet per hour. It is very evident we have got more light out of the gas through the medium of electricity than was got from the larger quantity of gas which those burners consumed. Our conditions here are somewhat unfavourable to my light for a fair comparison, but from measurements carefully made, both of light produced and current required to produce it, I am warranted in saying that at least twice as much light will be produced by a certain quantity of gas used to generate an electric current employed in my lamps than would be obtained from this quantity of gas burnt in gas burners in the usual manner."

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THE ELECTRICAL EXHIBITION AT PARIS.

Telegraphic Apparatus.

SÖMMERING.—It was Samuel Thomas Sömmering, born at Thorn in 1755, living at Munich from 1805, who first in the month of July, 1809, applied to telegraphy galvanic electricity. His interesting apparatus exhibited in the German Section is the youngest, then, of what may be termed practical telegraphs, for however ingenious the devices depending on static electricity there was no chance of their ever becoming much more than instructive toys. Sömmering's system was based upon the discovery of Nicholson and Carlisle that water is decomposed by means of the voltaic current. This inventor took a number of wires of brass, which he insulated first with a covering of gum lac and afterwards with silk thread, and then united them in a cable a thousand feet in length, also covered with thread and with heated gum lac or with a ribbon soaked in gum lac. He connected these wires at one extremity with a strip of gold placed upon cork at the bottom of a glass trough filled with water 170mm. long. by 25mm. wide and 65mm. high. The other ends of the wires were attached each to a metal strip, which had a hole made in it near the ends. These terminals formed what might well be called the transmitting board. His galvanic battery, according to Mr. Lines, was com-

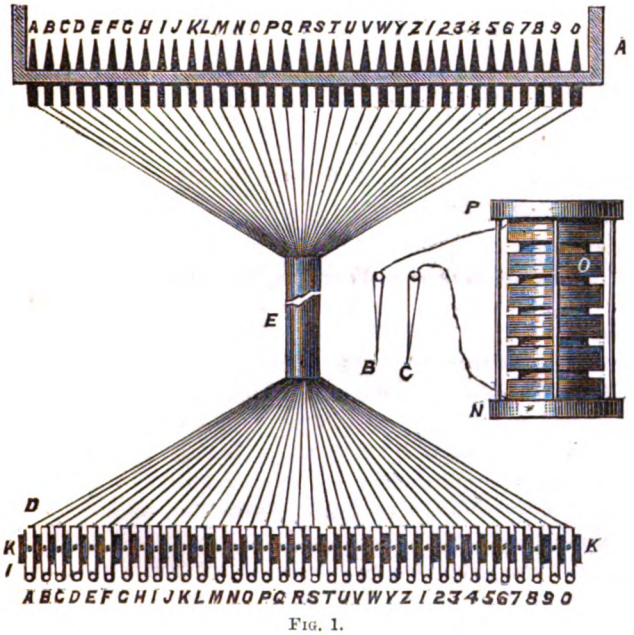

FIG. 1.

posed of 15 Brabant crowns and 15 plates of zinc, separated by round pieces of felt moistened with a saturated solution of common salt, to the poles of which were attached two plugs to be inserted as required in the holes in the terminals above mentioned. To send a signal, the two plugs were placed in the holes of the terminals of the wires representing the letters to be indicated. The current traversing the circuit caused a disengagement of hydrogen and oxygen at the receiving end. The letter indicated by the gold point from which hydrogen escaped took precedence over the other. If only one letter was to be signalled, the plug of the positive pole was put in the hole of the terminal representing zero, the negative pole being connected to the terminal of the wire indicating the letter to be sent.

In Fig. 1, A represents a section of the glass trough, in which are indicated the gold points, each with its respective letter or other sign. K K shows the transmitting table, with the metal terminals. E shows how the wires were arranged cable fashion. Sabine says of this invention:—"The construction of this telegraph involved an outlay which, in conjuction with the slowness of working, would have prevented its commercial utility, even if the science had not advanced by any of those astonishing strides which marked its progress a few years afterwards." Schweiger, of Halle, suggested simplifications and modifications of this apparatus; and Professor John Redman Coxe, of Philadelphia, in 1810, proposed to utilise for telegraphic purposes the decomposing action of the current upon different salts.

RONALDS.—Francis Ronalds, in a small work published in 1823, describes his "Electric Telegraph," as well as some other electrical apparatus. The English Government show in the Postal Telegraph Stand a specimen of the wire used by Ronalds in his experiments, also a model, &c.

Ronalds says, "Some German and American savants first projected galvanic or voltaic telegraphs by the decomposition of water, &c. But the other form of the fluid appeared to me to afford the most accurate and practicable means of conveying intelligence, and in the summer of 1816 I *amused* myself by wasting, I fear, a great deal of time and no small expenditure in trying to prove, by experiments on a much more extensive scale than had hitherto been adopted, the validity of a project of this kind. I believe I succeeded to the entire satisfaction of several very eminent scientific friends. . . The result *seemed* to be that that most extraordinary fluid or agency, electricity, may actually be employed for a more practically useful purpose than the gratification of the philosopher's inquisitive research, the schoolboy's idle amusement, or the physicians *tool*; that it may be compelled to

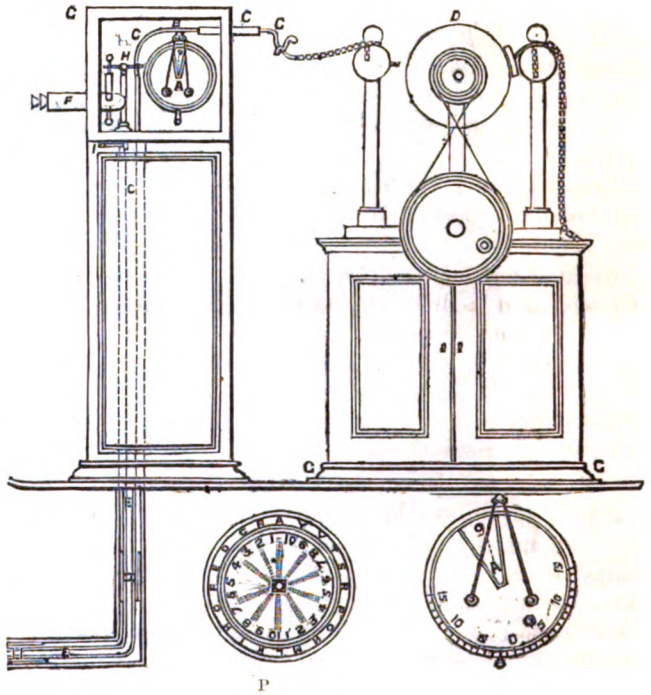

FIG. 2.

travel as many hundred miles beneath our feet as the subterranean ghost which nightly haunts the metropolis. . . . Why has no *serious trial* yet been made of the qualifications of so *diligent* a courier? . . . Let us have *electrical conversazione offices*, communicating with each other all over the kingdom, *if we can*. . . . Upon a lawn or grass plot at Hammersmith I erected two strong frames of wood, at the distance of twenty yards from each other, and each containing nineteen horizontal bars. To each bar was attached thirty-seven hooks, and to the hooks were applied as many silken cords, which supported a small iron wire (by these means well insulated), which composed in one continuous length a distance of rather more than eight miles. When a Canton pith ball electrometer was connected with each extremity of this wire, it was *charged* by a Leyden jar, both electrometers appeared to diverge suddenly at the same moment, and when the wire was *discharged* by being touched with the hand, both electromoters appeared to collapse as suddenly."

Reasons are given for abandoning this line of research. The following experiments are then described:—

"A trench was dug in the garden 525ft. in length and 4ft.

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deep. In this was laid a trough of wood, 2in. square, well lined in the inside and out with pitch, and within this trough thick glass tubes were placed through which the wire ran."

The tubes did not touch, but were connected by insertion at intervals into short pieces of tube of a larger diameter. The joints were sealed by a little *soft* wax, to exclude moisture. The trough was then covered with wood, screwed down while the pitch was hot, and well covered with pitch. The trench was then filled in.

"A light circular brass plate, P, divided into twenty equal parts, was fixed upon the seconds arbor of a clock which beat dead seconds. Each division was marked by a figure, a letter, and a preparatory sign. The figures were divided into two series, from 1 to 10, and the letters were arranged alphabetically, leaving out I, Q, U, W, X, and Z. Before or over this disc was fixed another brass plate, capable of being occasionally moved by the hand round its centre, which had an aperture of such dimensions that whilst the disc P, Fig. 2, was carried round by the motion of the clock, only one of the letters, figures, and preparatory signs upon it could be seen through the aperture at the same time. . . In front of this pair of plates was suspended an electrometer, Q, of Canton's pith balls, from a wire, which was insulated, communicating with a cylinder electrical machine, of only six inches diameter, and with the above described wire buried and insulated by the glass tubes and trough in the garden. Another similar electrometer was suspended in the same manner before another clock, similarly furnished with the same kind of plates and electrical machine. This second clock and machine were situated at the other end of the buried wire, and it was adjusted to go as nearly as possible synchronically with the first. Hence it is evident that when the wire was *charged* by the machine at *either* end the electrometers at *both* ends diverged. When it was *discharged* suddenly at either station they both collapsed at the same instant, and when it was discharged at the moment when a given letter, figure, and sign on the lower plate of one clock appeared in view through the aperture, the same figure, letter, and sign appeared also in view at the other clock; and that by such *discharges* of the wire at one station, and by noting down the letters, figures, or signs *in view* at the other, any required words could be spelt and figures transmitted."

This was the last attempt we shall refer to in which statical electricity was used for telegraphic signalling.

Miscellaneous Exhibits.

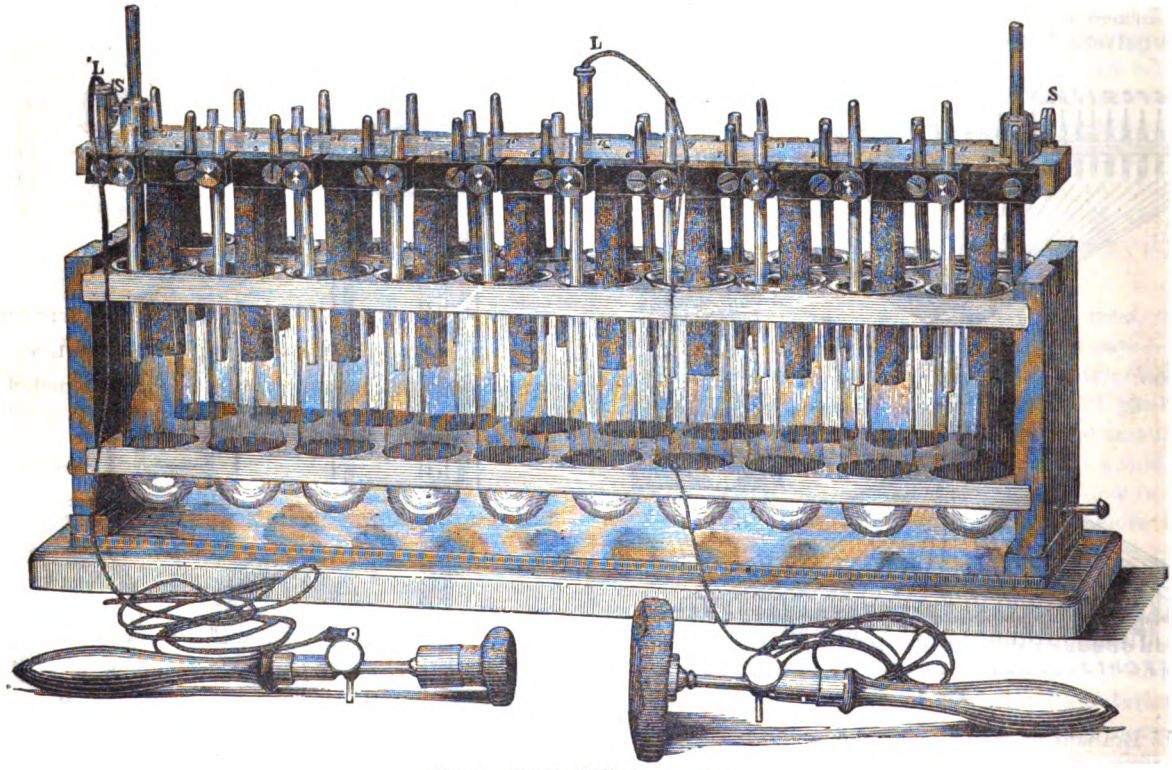

Fig. 3.—Electro-Medical Apparatus.

A large number of coils and batteries for electro-medical purposes are shown in this Exhibition. Among other exhibits Messrs. Fein, of Stuttgart, show a portable double apparatus (Fig. 4). This furnishes a constant current with or without interruption. It works with one battery of zinc-carbon elements fixed to a wooden plate by means of bent wire hoops. The liquid is contained by two ebonite troughs, which may be raised or lowered by two handles, the plates being kept out of the liquid when the instrument is not in use. A double spring slides over the wire hoops, making contact with two opposite elements. The induction apparatus is placed in a partition on the left-hand side of the box; the coil may be raised or lowered to regulate the force of the induced current. A commutator serves to enable the user to obtain the kind of current required — constant, induced, or extra.

Another apparatus of a simpler kind is shown (Fig. 3). The construction of this battery admits of an easy exchange of the elements, and assures a constant current. Here again zinc carbon bars are used, and are fixed by brass bands in a carrying strip, movable up and down between metal guide rods, and kept in position by two screws. The carbon bars are soldered into the bars, thus obtaining good contact, the zinc bars being fastened by binding screws, so that when used up new zincs can easily be inserted. The upper side of each band is furnished a tapering brass peg, to receive a contact piece at the end of the conducting cords and electrodes. The conducting cord has two such contact pieces to allow of the introduction of more elements without breaking the current. The excitor is a solution of 300 parts of water, 45 parts of pure sulphuric acid, 20 parts of bi-chromate of potassium, and two parts sulphate of mercury.

Another interesting piece of apparatus, also shown by Messrs. Fein, is an indicator clock, or an instrument which shows whether the watchman has visited the various parts of the factory, &c., at the proper times. The clock is placed under lock and key, so that it is safe from wilful or unintentional tampering. In the localities to be guarded, locked up signalling keys are placed; from each of these keys a conductor is carried to the clock, which contains as many electro-magnets as there are signalling keys. The watchman passing the keys at proper intervals presses a button, which

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action completes an electric circuit and sends a current through the corresponding electro-magnet, the armature of which is

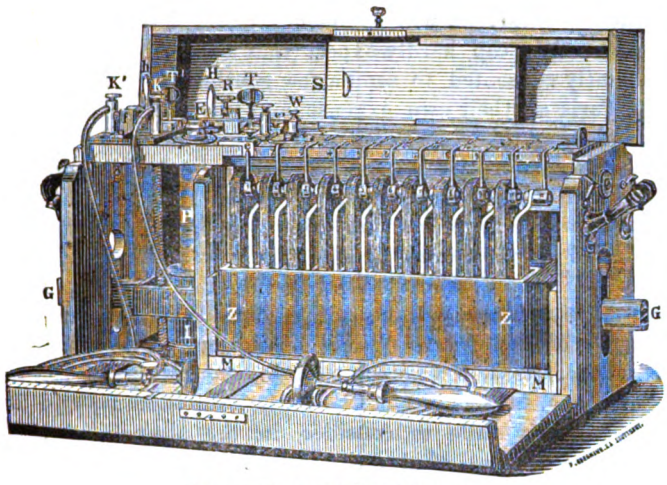
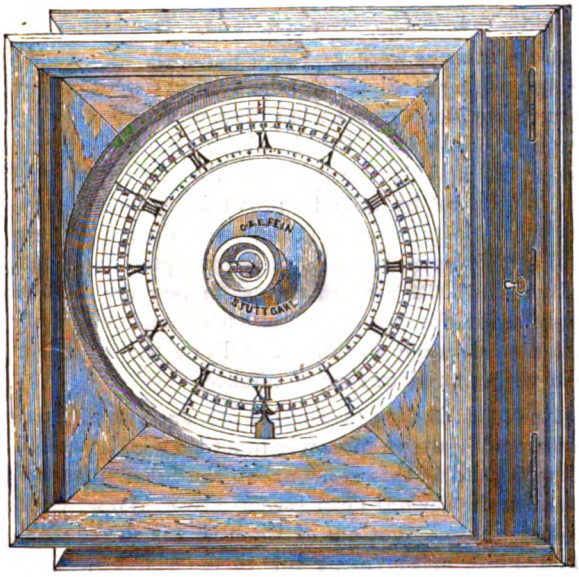


Fig. 4.—Electro-Medical Apparatus.

attracted, and the point of a needle fixed to it, thereby made to perforate a paper dial. The paper dial makes a complete



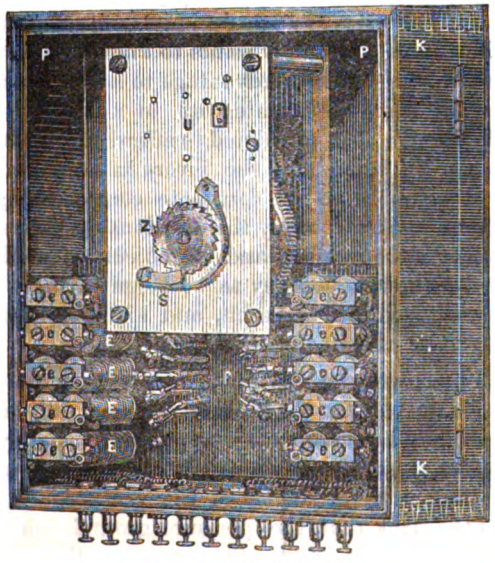


Fig. 5.—Indicator Clock.

revolution in twelve hours, when it must be replaced by a new one. A hand placed in front of the clock allows of its use as an ordinary time piece. The paper dial is by concentric circles and radial lines divided into small divisions; and the position of the different needle punctures shows whether the watchman had duly performed his duty and visited the points under his care in the prescribed order and time.

STANDARD RESISTANCE UNITS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: As an appendix to the letter and suggestion of Mr. Sprague, I would like to ask whether a standard resistance unit might not be defined absolutely by means of the tangent or sine galvanometer, viz., the resistance of a ring or rings of a given radius, which, when a given current was flowing, gave a certain deflection of the needle? As I have no doubt this method has often been thought of, I should be glad to know whether it has been set aside merely on the score of inaccuracy, as that I should fancy would be the greatest objection to it.—Yours, &c., G. A. Moore.

Liverpool, Oct. 10, 1881.

THE CONTACT THEORY OF THE VOLTAIC CELL.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In explanation of Mr. Fahie's experiment Mr. Fitz-Gerald states that "the current . . . is in reality due to the contact between the metals hydrogen and copper." May I ask, Are we to understand that a difference of potential would exist between hydrogen and copper in contact with one another without the intervention of any other substance or compound, and if so what is the evidence in support of this view?—Yours, &c., J. Brown.

Belfast.

THE TELEPHONE AND MAGNETISM.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I am not aware if the same phenomenon has been observed before, but I find that a sound resembling that of a sigh or effluent breathing is heard in a telephone which is connected with the ends of the coil wires of a large electro-magnet, both after the application of the current and after its cessation.

This sound lasts about two-thirds of a second, but is more distinct after the interruption of the battery current.—Yours, &c., F. Higgins.

The Exchange Telegraph Company (Limited), 17 and 18, Cornhill, London, E.C., Sept. 29, 1881.

WHO IS RIGHT?

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In the interesting *resumé* of telegraphic development which appears in your issue of 8th inst., the writer says, page 330:—"We do not hear that 'C. M.' (Charles Morrison, of Greenock) carried his ideas into practice." Prof. Tyndall, "Notes on Electrical Phenomena and Theories," referring to the first proposal of an electric telegraph, attributes it to an anonymous contributer to the *Scot's Magazine* for 1753, while Dr. Noad, "Student's Text Book of Telegraphy," page 408, says:—"On February 1, 1758, a Scotchman, Charles Marshall, of Paisley, then resident at Renfrew, published in the *Scot's Magazine* a full and clear description of a practicable electric telegraph."

In a volume of the *Scot's Magazine* for the year 1753, now by me, I find a letter "To the Author of the *Scot's Magazine*, dated Renfrew, February 1, 1753, and signed 'C. M.,'" but in another for the year 1758, I can find no trace of "C. M." or his letter. Will some reader kindly say who is right, and on what authority "C.M." has been extended?

In connection with the experiments of Grey the name of Mr. Wheeler is introduced; this reading while agreeing with Lardner's, and some others, differs from Ferguson's, who calls Grey's assistant Wehler, is this to be taken as corruption of Wheeler or *vice versâ*?—Yours, &c., F. M. K.

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THE ELECTRICIAN.

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THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

Imitation being the best form of flattery, the French nation will take much credit to itself for the Electrical Exhibition proposed to be held at the Crystal Palace during the forthcoming winter. Nor will the compliment be undeserved. Whatever may have been the motive, the project itself of an exhibition of this kind in Paris was on all hands felt to be a bold if not a hazardous one. Originating with a Government Department, and aided by the bountiful resources of the State, absolute failure was not to be apprehended; exhibits were sure to be forthcoming from every quarter of the globe, and there could be no fear as regards the value of the collection thus brought together. The one serious cause for doubt in the stranger's mind was the amount of interest likely to be taken in a scientific exhibition of this kind by the people at large. It has turned out that the originators knew their fellow-countrymen best. A new sensation is always acceptable to the true Frenchman, and to the Parisian pre-eminently. Such a sensation the displays of electric lights, the feats of the telephone, and similar wonders have amply provided, and the huge building was visited by large crowds. Of its scientific results it is, perhaps, too early yet to speak, and its commercial side can only be looked at from a conjectural future; but considered even as a mere place of amusement, the exhibition has been fairly remunerative; and in any case the merit, as well as the profit attending a first novel and highly instructive undertaking, belong to the French Government.

The exhibition which it is proposed to hold in the neighbourhood of London will commence under less influential auspices. We can hardly expect that a Government which reluctantly consented to send a few gentlemen to represent it in Paris at their own expense, and was not ashamed to stand alone in this respect, will evince any unwonted interest in a similar enterprise nearer home. To be truly national, or, rather, that it may appear to be so to other nations invited to take part in it, an exhibition should be directly patronised by the Government of the country in which it is held; and one of the difficulties the English promoters will have to encounter will be the essentially self-dependent character of the Crystal Palace exhibition. They will be fortunate, indeed, if they succeed in making it an international one, such as in fact the Paris Exhibition is; and it will be worth while to consider, in the absence of this element of success, what may actually be counted upon to make up for it.

In the first place it cannot be said that any one country, France of course excepted, is fully represented at Paris just now; and this is, perhaps, peculiarly true of Great Britain. We have not sent all, or nearly all, of what we could contribute under more favourable circumstances. Remembering what those circumstances were, and how narrowly we escaped contributing nothing at all, the wonder is that we cut the respectable figure we do. The nation that was first to adapt the telegraph to public uses, that has been ahead of all others in extending it, and is foremost in the study of electrical science, ought to be able to prove its pre-eminence at an international electrical exhibition. We do not suspect that any feeling of disappointment has prompted the conception of a rival exhibition on our own soil; but the ambition to have full scope for displaying our merits as they deserve is at least a pardonable weakness, and one which we may indulge in without risk or fear of offence.

The time, too, is very favourable for such an exhibition in this country. We are an intensely practical people, and all eyes are being turned at this moment on the future utilities foreshadowed in the several most recent electrical discoveries. If good service is to be got out of them this is the country that will find most employment for them. That it is not in a hurry to adopt untried novelties only proves its sound common sense. It cares very little for pretty spectacles or pretentious inutilities; it simply wants to know on trustworthy evidence what will be to its advantage to adopt. Such evidence has not been forthcoming up to now; and a local public exhibition is best calculated to afford the much needed information. The awards of the jurors in Paris will be impartial, and valuable to the fortunate competitors; but to the consumers in this country the decisions of jurors on the spot will carry more weight; and the objects themselves can be inspected without a journey to "foreign parts." This to the average Englishman is much, and his liberal patronage may therefore be safely counted upon.

We shall have more to say on this subject as the scheme takes definite shape; for the present we need only add that the choice of building seems to us peculiarly happy. The Crystal Palace possesses attractions of its own that will contribute to the pecuniary success of the venture. When we add to this the fact that the pleasure grounds on the one hand, and the unique glass edifice on the other, will lend themselves admirably to the purposes of electric illumination there seems little reason to doubt that the patronage of the curious multitude may also be enlisted.

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MANUALS OF ELEMENTARY SCIENCE.*

(From *La Lumière Electrique.*)

ELECTRICITY.

PART I.—STATIC ELECTRICITY.

A comparison between elementary treatises of twenty years ago in any branch of natural philosophy with those written at the present day will show how great has been the change that has taken place in the methods of treating the subject. A book on experimental mechanics is now something more than a mere collection of woodcuts illustrating the mechanical powers; endeavours are made in it to convey exact notions derived from the idea of mechanical work. Similarly, an elementary mathematical treatise on the subject of mechanics is not merely a reproduction of dry theorems about matters known only to pupils by words, but it constantly refers the results of logic to the test of experiment. So it is in other departments of physics, and, notably, in the subject of electricity.

Prior to 1873 books on electricity were of two kinds—the elementary ones, containing accounts of experiments, illustrated with more or less well executed pictures of historical apparatus, apparatus possessing in many cases numerous defects, and which the students ought to have been warned against imitating rather than induced to construct from seeing it depicted in all text books of this class. There were the stock illustrations of electric machines, boys with radiating hair, standing on glass-legged stools, electric pistols, and the magnificent appearance of the electric discharge, and the information vouchsafed to readers referred to the electric shock on animals and men, while any indication that electricty was an exact quantitative science was entirely absent. The other class of electrical literature was of a totally different kind, and consisted of stray mathematical papers scattered through the proceedings of various scientific societies almost inaccessible to the majority of students, and quite incomprehensible to the younger ones when found. But, in addition to the literature, there was an exact science of electrical testing, a science almost unwritten, but one well understood by the practical electrician; and, indeed, as Professor Fleeming Jenkin aptly remarked in the preface to his first book on electricity and magnetism, published in that year, this knowledge of the practical men was far more scientific than that of the schools. Professor Jenkin's first book had for its object to show how the experimental knowledge and the mathematical knowledge of electricity were linked together, and how both were of value to the practical electrician. Naturally, then, this treatise became the recognised text-book on the subject.

But, excellent as it is, and prominent as it always will be in marking the commencement of a new era in English electrical text books, it has been found to be too difficult for beginners, and they hoped to find in Professor Jenkin's new manual, just published, something more suited to their comprehension. As a matter of fact, however, the subject of electricity is a very difficult one. We may have elementary treatises on mechanics, or even on optics, but it seems almost impossible to have a really elementary treatise on electricity. This probably arises from our having no electrical sense, whereas we have an optical sense, and all our other senses are affected by heat and by mechanical forces. From our earliest infancy we have a practical acquaintance with hot, cold, light, dark, heavy, light with the effects of forces steadily applied, and with impulsive forces, and indeed, so much are we influenced by mere experience that beginners always wrongly regard matter as possessing an innate power of stopping itself, so biassed are we by the universal existence of friction. But in electricity and magnetism our early knowledge is confined to the phenomenon of thunder and lightning, so appalling in childhood, and to the occasional sight of the wonderful effect of a magnet holding up a piece of iron. That an ordinary fire warms the whole room, the floor, walls, ceiling, and even the upstairs rooms, is easily learnt by the child, but that a magnet has an equally extensive field of influence, and is causing a stress in all surrounding space our senses give us absolutely no indication of, and, therefore, the fact is as unknown to the ordinary man as to the child.

Although the reading of this new manual of electricity has given us the greatest pleasure, and, although we cannot too much admire the skill with which an attempt has been made to give exact notions to beginners, we fear that many of them who take up this book will be greatly disappointed, and perhaps repelled from the study of electricity in consequence. Indeed, it is those who already know the subject most fully who will derive most pleasure and benefit from perusing Professor Fleeming Jenkin's new text book. But the fault lies most with the readers themselves, for if students expect by an elementary treatise on electricity to find one that may be clearly understood by a beginner without the help of a fairly complete course of experimental work, then we fear they are expecting an impossibility. No one, for example, can have any exact knowledge of the modern science of electricity unless he has a clear conception of what is meant by difference of potentials, but we fear that unless any written description is supplemented with many experiments performed by the learner himself, his ideas on this subject will be very hazy. Much, of course, can be accomplished by well selected experiments shown at the lecture table, but it is only by an ordinary student passing through an organised course of laboratory practice that he can obtain such a grasp of the subject as will enable him to image those conceptions which otherwise remain mere mathematical symbols. Indeed, we venture to think that it is because in France students have had less practical familiarity with electrical measurements than in Great Britain, in consequence of there being in this latter country a greater number of manufactories of submarine cables with their testing rooms attached, that has caused the exact study of electricity to make during the last twenty years less rapid progress in France than in Great Britain.

But, assuming the reader is not one of those who hope to learn swimming, bicycling, or electricity merely from a book, then Professor Jenkin's manual will be of the greatest assistance to him, even although he be a little puzzled by the two conflicting ideas that appear to have been constantly putting the writer in opposite directions—the desire on the one hand to make the explanations complete, on the other to make them simple. For, in all electrical phenomena completeness requires that the action produced by the electric charges induced on the walls, ceilings, and floor of the room in which an experiment is conducted should be taken into account; simplicity, on the other hand, requires this action to be ignored, or, what is the same thing, to always assume the walls are at an infinite distance. The older writers on electricity merely attempted simplicity, possibly because they were really quite unacquainted with the complete conditions controlling any electrical phenomenon. It would have been impossible as an elementary manual such as that we have under review for Professor Jenkin to have taken into account all the conditions influencing the result without sacrificing brevity to exactness; in fact the book would have had to have been very much longer. He, therefore, takes a sort of intermediate course. Drawing an analogy from mechanics, it is as if the older writers considered all bodies as perfectly rigid and smooth, Professor Jenkin considers them to be slightly yielding and rough, but generally ignores their flexibility and roughness, while in reality, to complete the analogy, they ought to be regarded always as having considerable flexibility and roughness. The result of this most praiseworthy attempt to combine accuracy with simplicity has, in certain instances, introduced a certain element of vagueness; for example, on page 20 we find, "Let us place two conductors in a constant relative position with a constant dielectric, such as air, between them, and let us surround this system by an uninsulated shell, so that no charge can be induced upon them from without. The charge on the two bodies will be proportioned to the difference of potentials." Now, a beginner would gather from this that it was a general law that the charge on two bodies in a fixed relative position was propor-

* By Professor Fleeming Jenkin, F.R.S. [Society for Promotion of Christian Knowledge.]

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tional to the difference of potentials between the bodies in question, and was quite independent of the distance of the uninsulated shell, and we fear he certainly would not imagine that the simple law as stated was an exception, only holding true when the surrounding shell was very large and far away, so that its coefficient of induction on either of the bodies was very small in comparison with the mutual coefficient of induction of the bodies one on the other. The same possible misconception is contained in the statement:—"We may with equal propriety speak of difference of potentials between two conductors as the cause of the charge upon them; or of the charge upon the conductors as the cause of the difference of potentials between them," and again on page 39 we find, "The inner and outer coatings of a charged jar contain quantities of electricity of opposite signs wholly distributed over the surfaces where the coatings touch the glass," a statement that, if true, would make it impossible to discharge a Leyden jar by alternate contact, that is by alternately insulating each coating, and connecting the other coating with the earth. In fact in all condensers which do not consist of one shell, completely surrounding the other, the charges on the two coatings are unequal, or rather there must always necessarily coexist two condensers, one having the walls of the room for one of its coatings, a condition that should be always present in the mind of an experimenter.

On the other hand, on page 41, and onwards in the book, the necessity of considering the action of every body in the neighbourhood is very properly impressed upon the student, and he is warned that the position of his own body, and even of his hand, modifies the form of the surrounding uninsulated shell. We should have preferred to see the general case treated first, and then the simple exceptional cases taken afterwards, rather than the risk should be run of the beginner getting simple rules into his head, such as if the potential of one coating of an insulated condenser is raised, that of the other is raised in equal amount,which are only true in exceptional cases, but which he is sure to apply generally to his discomfort.

We are delighted to find on page 21 not merely the statement, "The word tension has been used by various writers in various senses," but also an exact definition of what *electric tension* should mean—viz., a *force* per unit of area tending to tear off the surface of the charged body, and which definition, if closely adhered to, will prevent all further confusion between difference of potential and difference of electric force.

In the paragraph referring to the non-insulating character of glass supports in the ordinary air, probably brevity prevented the author giving an account of the modern methods first introduced by Sir William Thomson, of systematically placing all such glass stems in an atmosphere artificially dried with sulphuric acid, or with some similar absorbent of moisture, instead of the student being merely told of the necessity of warming the glass stems, or of coating them with shellac. In the present day there is no difficulty in performing all experiments on statical electricity without resorting to the old-fashioned plan of attempting, by means of red hot balls, fires, &c., to dry a whole room, or at any rate the whole space surrounding the lecture-table, in order to maintain two or three glass stems in a state of electrical efficiency. There is nothing, for example, to prevent the gold leaves in an electroscope from being supported by a glass rod entirely inside the glass case, and kept artificially dried by a small vessel of sulphuric acid inside, while the wire charging the gold leaves merely passes through, but does not touch the neck of the glass shade. With such an apparatus the glass shade may be entirely covered with tin foil, to screen the leaves from internal induction, holes only being left to see through, and yet the insulation of the apparatus is necessarily so perfect, that there is no perceptible loss of charge during many hours, even in the dampest weather. But, as far as we are aware, Messrs. Paterson, of London, are the only firm who make gold leaf electroscopes in this sensible way, and in no book did we ever see any illustration or other indication that an electroscope ought not to be constructed by supporting the gold leaves from a glass tube, or ebonite plug, stuck in the neck of the glass shade.

The explanation given by Professor Jenkin of Thomson's replenisher, on page 46, is extremely clear and convincing, and we would recommend it to all students, who, from the complicated descriptions usually given in books of the action of the Holtz machine, have hitherto failed to grasp the fundamental principles that underlie the actions of all inductive electrical machines.

It is so easy to explain electric attractions by the theory of positive and negative electricity that, like most other writers, Professor Jenkin uses this expedient, but we feel that in Article XII., which gives an excellent account of attractions due to induction, he might have added very much to the exact information of beginners if, after his first explanation following from the above assumption, he had then considered the other assumptions that have been made to explain the motions of electrified bodies. *Qualitative* phenomena in electricity are usually explained on the two fluid hypothesis, *quantative* on the one fluid; but there is this great defect in the ordinary mathematical theory as usually studied, that the apparent attractions of positively and negatively charged bodies cannot be deduced from the simple hypothesis of a single electric fluid or substance, every portion of which repells every other portion with a force inversely proportional to the square of the distance, the fundamental hypothesis made in the ordinary mathematical theory. We think in the very early portion of even an elementary book on electricity the student should be taught to realise the probability of all electrical action arising from a strain set up in the insulating medium, so that he should not even be able to conceive what most beginners think they can so easily realise—viz., one electrified body existing alone in space. If the very existence of electricity suggested to them a strained spring extending between the equal and oppositely electrified bodies, which must always exist together, they would no more be able to imagine a single electrified body existing alone than they could imagine a spring stretched by a weight hanging from one of its ends, whilst its other end was not supported by any hook or nail. It does not seem to have occurred to those who use the one fluid theory that an uncharged conductor, which, on the one fluid theory, means a conductor with a normal amount of electricity spread uniformally throughout it, does not represent a possible condition of electric equilibrium, unless we asssume a uniform volumetric density of electric charge throughout all space which is commonly regarded as uncharged; in other words, if the absence of electricity inside a charged conductor means merely normal density, while the charge on the surface means excess or defect in density, then throughout all space without limit there must exist a uniform electric distribution of the normal density to maintain the normal distribution in the interior of conductors.

Section 28, on "Atmospheric Electricity," is not very clear. The sentence, "In fine weather the air is usually positively electrified and the earth negatively electrified by induction," is quite contrary to all the student has previously learnt about the impossibility of a charged envelope acting inductively on the space inside it; since if the earth existed in space unelectrified, and a positively electrified atmosphere were now placed round it, there would be no inductive action to electrify the earth negatively. There has been much discussion as to the relative value of points and balls at the end of lightning conductors, and a large portion of it has been, we think, rather of a useless kind. When a great quantity of electricity has to be discharged suddenly there seems to be no doubt that a point and a ball are about equally efficient; and we are inclined to think if larger quantities are employed than are usually dealt with in experiments on statical electricity it will be found that the ball is the more efficient of the two, and a larger ball more efficient than a smaller one, in consequence of the greater electric capacity of the former. But to fulfil the other purpose of a lightning-rod, viz., to dissipate, or neutralise, the electricity in a charged cloud moving slowly up to the neighbourhood of the lightning-rod, then a point will be probably more efficient than a knob or ball. The much-debated question as to whether the resistance of a lightning-rod depends merely on sectional area or also on surface is necessarily not touched on in this elementary

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manual. Much of the difficulty that has attended this discussion has arisen from the meaning of the word resistance, as applied to a lightning-rod; for if resistance merely means the opposition to a steady current, then, of course, the surface can have nothing to do with the question, since the resistance of a rod of given material, and at a fixed temperature, merely depends on its length and sectional area, but if resistance means the opposition to a sudden discharge of electricity, then there is equally no doubt that the diminution of the *co-efficient of self induction*, arising from giving extra surface to the conductor, must necessarily diminish its resistance. In fact, the well-known equation for the *starting* of a current shows exactly how much the resistance of a lightning rod to a sudden discharge of electricity through it is lessened by diminishing the co-efficient of self-induction through increasing the surface.

The end of Chapter II. is extremely good; the feelings we should have from the omnipresence of electric phenomena if we only had an electric sense is well and, indeed, poetically worked out. We have often longed for the possession of a cat's eye to see with in the dark; we now long for a cat's whisker, which, as the author says, may be sensitive enough to perceive ordinary electrification. Nothing shows, perhaps, more clearly the improvements that have in recent years been effected in apparatus for electrical measurements than the fact that, whereas it was only after careful drying that the stick of glass after being rubbed would evidence sufficient electricity to affect the instruments such as are still drawn in many of our text books, the difficulty of to-day is to pick up anything off the table which a delicate electrometer will not show to be already electrified by previous contact with some dissimilar substance. "We are learning," says the writer in concluding this chapter, "that electrical phenomena are not isolated, but from one group of the vast series of effects due to an imponderable medium in which, and by which, matter exists; light, electricity, heat, and gravitation, all depend on this medium, and are in some way connected with one another and with massive matter. Much remains to be done to make this connection clear, but the dependence of electrical phenomena one upon another is well understood, by which words we mean that the conditions of an electrical problem can be set down numerically, that all electrical results can be expressed numerically, and that the connection between data and their consequences can either actually be calculated or is seen to be calculable."

W. E. Ayrton.
John Perry.

ATMOSPHERIC ELECTRICITY IN AMERICA.

We take the following remarks from the *Monthly Weather Review* of the United States General Weather Service for July of this year:—

"The following items of interest connected with the peculiar manifestations of electricity during the progress of thunder storms in July were obtained from various sources:—La Crosse, 21st, church spire demolished, six or seven houses badly damaged, and a number of barns burned. Oakland, Wis., 21st, several buildings struck and burned. Port Washington, Wis., 21st, three boys, while crossing a bridge at a rapid gait, and elbow to elbow, were enveloped by a flash of lighting, instantly killing the two outside boys, while the middle one was left uninjured. Richmond, Va., 13th, about eight miles from town a large tree was set on fire by electricity, and a shell which was lodged in the tree during the late war was exploded thereby with a deafening report. Carr Station, Col., 16th, a cow boy while riding his horse to seek shelter from the storm was instantly killed; his body was terribly disfigured and burned; the horse had its head split open and brains scattered about, while the remainder of the body was badly mangled; all the metallic portions of the saddle and bridle were burned off. On New York Bay, 15th, a small fishing schooner containing two ladies and one gentleman, had its mast shattered to splinters down to the step, without doing the slightest injury to the hull of the boat or its occupants; the heads of the ladies were within one foot of the mast when struck. Grafton, Ohio, 31st, in passing through the roof of a residence near one of its chimneys the electricity entered a room below where two little girls were playing. It struck one of them on the head and passed down the right side of her face and over her breast to her knees, leaving a mark about two inches wide and completely stripping off her clothing, which was torn into shreds; the child was instantly killed while her companion remained uninjured. Saugus, Essex Co., Mass., 21st., electricity entered the telegraph office upon a wire connected with the instruments, burning off the connections and completely destroying one of the wires; a lady who sat about two feet distant from the instrument table, copying a message, had her pen and penholder melted in her hand, the paper was scorched, the carpet was burned, torn up and blackened and the room filled with smoke; there were several sharp crackling explosions, which were heard a considerable distance; the lady experienced no sensation, except a slight pain in her side nearest to the instruments, otherwise she was perfectly uninjured; the walls of the house were scorched and blackened along the course pursued by the electricity. Concord, N.H., 21st, the wires of the Telephone Exchange were completely burned out, stopping all communication with surrounding towns. Schuylkill and Columbia Co.'s, Pa., 29th, most violent thunderstorm for years; several persons killed by lightning and many buildings along the course of the storm badly shattered or burned. Waunakee, Wis., 20th, most violent thunderstorm for past 25 years; the electricity tore a hole about 6ft. long in the roof a house, and passing thence down the chimney, demolished every wire screen door in the building without injuring the occupants; 26 pigs, lying under a tree 25 rods from the house, were instantly killed. Freemont, Ohio, 8th, three horses instantly killed in an open, treeless field. Chicago, 20th, house struck, tearing off the shingles and siding as though so much paper; the electricity appeared to envelop the whole building, knocking the chimney into sections, cracking the stove and demolishing the windows; one person instantly killed in a group of three and the others seriously stunned. Columbus, Ohio, 22nd, house struck, tearing the chimney to pieces and filling the rooms with soot; the inmates were not injured in the least. Delaware, Ohio, 22nd, at a point about eight miles west of town, electricity passed down the chimney of a house, splintering several joists; then moving onward and down the sides of the building it entered the room below, tearing a bed into shreds; from here it passed to a cook stove in an adjoining room, breaking it into innumerable pieces, and passing thence to a man who stood near, ran down his arm and leg and disappeared through the floor, in which it left a large hole. This person complained afterwards of sharp pains passing from one leg to the other, and was unable to close his hand. Mount Washington, 16th, the electricity entered the printing office at the summit, scattering a case of type; it also burnt one of the wires in the telegraph office; in the *Signal* office it burnt the telephone wires, passed half way round the room, burning the wires in several places and scorching the woodwork."

Volt-Webers, Kilogrammetres, and Horse-power.—In the abstract of the paper referred to by "R. H. M. B.," the fourth column should commence 1·21, and a corresponding alteration be made in the position of the decimal point in the tables throughout.—[Ed. *E.*]

The German Association.—The annual meeting of this association was held last month at Salzburg. Amongst the papers read were the following, viz.:—"On a Direct Measure of the Attraction between the Earth and a Determined Electric Current," by Herr Sacher, of Salzburg; "On the Electro-Magnetic Rotation of the Plane and Polarisation of Radiant Heat," by Herr Grunmach, of Berlin; "On an Apparatus for Demonstrating the Different Action of Hollow and Solid Electro-Magnets," by Herr Waltenhofen, of Prague.

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CANTOR LECTURES.*

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

BY PROFESSOR W. GRYLLS ADAMS, F.R.S.

LECTURE III.—DELIVERED MONDAY, MARCH 21, 1881.

(CONTINUED FROM PAGE 317.)

MAGNETIC MACHINES.

The same reasoning will apply to the case where a permanent magnet is used in place of the original battery current, a closed circuit being moved in the magnetic field, or a magnet moved in the neighbourhood of a fixed coil. In fact, the theory of Ampère requires that a small closed current should be equivalent to a magnetic molecule, and so a collection of equal small closed currents, all going the same way, and occupying a given area, is equivalent to a collection of equal magnetic molecules with their poles in the same direction, *i.e.*, to a magnet. But a collection of equal small closed currents all going the same way, and occupying a given area, is equivalent to a current around that area.

We may readily expresss the efficiency of magneto-electric machines by a formula. Taking k to be the effective work done by a unit current in one turn of the armature, and n the number of turns in a minute, and C the strength of the current, the total effective work is C^2nk; and the work done in overcoming the resistance, R, of the circuit is $C^2R\theta$: hence, by Joule's and Ohm's laws, if E be the electromotive force,

$$E\,C = C^2\,n\,k + C^2R.$$

$$\text{Henee the efficiency} = \frac{C^2\,n\,k}{C^2\,n\,k + C^2R} = \frac{1}{1 + \frac{R}{n\,k}}.$$

Thus, for a given resistance, the greater the number of turns of the machine, the greater is the efficiency, and the higher the resistance the less the efficiency. This formula shows that machines and lamps of high resistance can only be efficient when the machines are revolving at a high speed.

We may represent the efficiency of batteries or magnetic machines which are employed to drive an electro-motor, such as a dynamo-electric machine, by a diagram from *La Lumière Electrique*, in which the electromotive force of the battery or exciting machine is measured on a horizontal line, and either the current or the energy expended is represented by vertical lines. The total electrical energy, represented by a straight line (III.), is the sum of the effective work (IV.), and the loss of energy by heating, &c. (VI.)

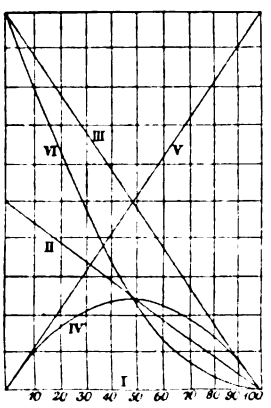

FIG. 3.

I. Electromotive force. II. Strength of Current. III. Energy converted into electricity. IV. Effective work in the external circuit. V. The efficiency. VI. Energy not converted into useful work.

It will be seen that when the efficiency is ½, the greatest amount of effective work is produced, and this amount of work is one-half the total electrical energy. Since the electromotive force is proportional to the number of revolutions a minute, this diagram gives the effective work and efficiency at different speeds.

In the case where the fixed and the movable parts of the machine are electro-magnets, and the same current passes round both, then we have—

(1.) The action of the currents on one another.

(2.) The action of the fixed magnetic core on the movable coil, and of the movable magnetic core on the fixed coil.

(3.) The action of the two magnetic cores on one another.

Hence the value of k is of the form $a + bm + cm^2$, where a, b, c are constants, and m depends on the magnetic properties of the cores.

Each of these actions arises from the influence of two equal currents on one another, and therefore will be proportional to the square of the current and to the number of turns of the coil in a minute, so that

The most important part of the action in such machines depends on the action of the two magnetic cores one upon another. The reactions between the fixed and the movable cores produce great disturbance in consequence of the cores not taking up their full magnetism instantly, but requiring time for their full magnetisation. In consequence of this, in all dynamo-electric machines it is necessary to allow the rotation to go on, through an angle determined by the retardation of the magnetism of the cores, before taking away the current from the machine to do external work; hence, in order to get the greatest current, the springs for making contact must in such cases be shifted round in the direction in which the rotation is taking place. Faraday attributed this retardation to the time required to develop the molecular currents in the molecules of the magnet.

ALTERNATE-CURRENT MAGNETO-MACHINES.

In alternate-current machines, there is no commutator for making the current continuous; but the currents from the coil are collected and sent through the external resistance in opposite directions for every half-turn of the armature. The earliest of these was the "Alliance" magneto-electric machine, which has been adopted by the French Government for lighthouse illumination. Holmes converted this into a continuous-current machine, and was the first to produce, in 1858, the electric light on a grand scale for lighthouse illumination. He afterwards removed the commutator, and again converted it into an alternate-current machine.

The four methods of placing the coils on the revolving wheel, in machines for electric lighting, which have been employed in lighthouses, have been summed up by Mr. Douglass:—

1. In Holmes's magneto-electric machine the bobbins are arranged transversely, with their axes parallel to the axis of rotation around the circumference of the wheel.

2. In Siemens' machines, the wires are lengthwise, and revolve about the long axis of the piece on which they are wound.

3. In Gramme's machines, the wires form a helix around a ring.

4. In the De Meritens machines, the wires are wound as in the Gramme, but are divided into separate parts, which are insulated from one another, and passing in succession in front of opposite poles of magnets, give off alternate currents.

THE SIEMENS ALTERNATE-CURRENT MACHINE.

A central disc carrying bobbins is set at right angles to a shaft, and revolves between two sets of electro-magnets ranged in circles on each side of the disc, having their axes parallel to the shaft. The bobbins have no iron cores, and so the heating caused by magnetisation and demagnetisation of the iron is avoided. The electro-magnets are excited by a small Siemens continuous-current machine.

This is similar to Wilde's dynamo-electric machine, which he produced in 1866, except that in the coils on his cast iron disc Wilde placed soft iron cores, and arranged them so as to form eight groups of four each. The current from one of these groups excites the electro-magnets, whilst the other seven groups give out the current for external use. Among the more recent alternate-current machines, arranged so as to be excited by a separate continuous current machine, there is one which has lately been invented by M. Gramme, in which the bobbin of the continuous-current machine, which excites the magnets, is placed on the same axis with the rotating armature which gave the alternate currents, so that the two turn with the same velocity, and the combined machines run at the same rate. This is much simpler than having two machines, and it is called a self-acting machine.

From principles which I have already explained, the greatest amount of effective work or yield obtained from an alternate-current machine, driven by a separate exciter, is not more than 50 per cent. of the electrical work given out by the first machine.

* Reprinted from the *Journal* of the Society of Arts for August, 1881.

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Result of M. Mascart and M. Jamin's Experiments.

M. Jamin has found that, in the Alliance machine for electric light and giving alternate currents, the strength of current can be calculated by Ohm's law, considering the electromotive force as proportional to the velocity, but replacing the resistance of the bobbins by a resistance about eight times as great. The resistance to be added is proportional to the velocity of the machine.

All theoretical determinations of the efficiency of machines are complicated by the retardation of magnetisation of the magnets, which necessitates a change of position of the commutator in the direction of the rotation of the armature. If this change were not made, then it would be possible, with a bobbin in which the wire resistance was high, to get currents in opposite directions when the coil is rotated at different rates. For slow rotation, the galvanometer needle is deviated to one side; on increasing the velocity of rotation, the current is increased, at last reaches a maximum, and beyond that diminishes rapidly to nothing, and becomes negative; as the velocity is still increased the current reaches its greatest negative value, and then increases again, and may have several such fluctuations.

The efficiency of the Siemens dynamo-electric machines has been examined experimentally by Dr. C. W. Siemens, who has communicated the results of his investigations to the Royal Society, and by Dr. Hopkinson, whose results are published in the *Transactions of the Institution of Mechanical Engineers*; also M. Hospitalier and Messrs. Auerbach and Meyer have experimented on Gramme machines, and M. Mascart and Angot have considered the subject, both theoretically and practically, in some excellent papers which have been given in the *Journal de Physique*.

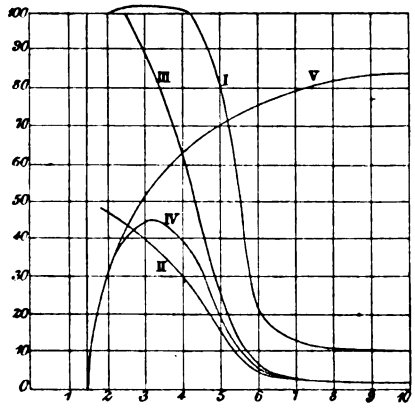

Fig. 4.

I. Electromotive force. II. Strength of current. III. Energy converted into electricity. IV. Useful work in the external circuit. V. Efficiency.

Taking the experiments of M. Hospitalier as given in *La Lumière Electrique*, we get the results, as shown in the diagram.

	Ohms.
The total resistance of the machine before the experiment was	1·185
,, ,, of the heated bobbin	·75
,, ,, of the heated electro-magnet	·72
Total	1·47

The resistances are laid down on the horizontal line to the scale of 1 cm. per ohm.

The scale of electromotive force (I.) is 1 cm. for 10 volts.

The scale for currents (II.) is 1 cm. for 10 webers.

The scale for work (III. and IV.) is 1 cm. for 20 kilogrammètres.

Curve (V.) represents the efficiency, *i.e.*, the ratio of the effective work in the outer circuit to the total work converted into electricity.

The curve expresses the ratio of the external work to the total work produced, and approaches the value unity as the resistance is increased; but for high resistances very little work is produced. From the curves it would appear that this Gramme machine does most effective work in the outer current, without greatly heating the internal circuit, when the total resistance is about 4 ohms, *i.e.*, when the external resistance is about twice as great as the internal resistance. For less resistances the machine is greatly heated from the amount of internal work consumed, and for higher resistances the work converted into electricity becomes very small. The following numbers give the results of one experiment with the dynamo-machine:—

No. of turns a minute	1,000
External resistance	2·7 ohms
Current	25·5 webers
Electromotive power	107 volts
Total work converted into electricity	3·64 h.-p.
Effective work in external circuit	2·38 h.-p.

The efficiency in this case is 65 per cent. The effective work in the outer circuit is not more than 50 per cent. of the total work done to produce it.

With Gramme Machine.

In Auerbach and Meyer's experiments for 800 revolutions a minute, the maximum electromotive force is 76 volts, and for 51 volts, or two-thirds of the maximum value, there is a current of 6·5 webers through a resistance of 7·8 ohms. Below this value the current is unsteady. With Siemens's machine, a speed of 700 revolutions a minute gave a maximum electromotive force of 76 volts, and for 51 volts there is a current of 15 webers through a resistance of ·6654 ohms. With a small Siemens machine, a speed of 1,000 revolutions per minute gave a maximum electromotive force of 42 volts, and for two-thirds of this, or 28 volts, the current was 11·2 webers through about 2·2 ohms resistance.

Dr. Hopkinson has investigated the way in which the electromotive force in a Siemens machine depends on the current. He has shown that:—

1. The electromotive force is for a given current, proportional to the speed of revolution of the armature.

2. That the electromotive force does not increase indefinitely with increasing current, but,

3. Only increases in the direct ratio as the current increases up to about two-thirds of its maximum value.

The current is very unstable for small changes of resistance, or of speed of engine, as long as the value of electromotive force is less than two-thirds of its maximum value. There is a remarkable difference in the ratio $\frac{E}{C}$, depending on change of speed from 660 to 700 revolutions a minute, shown in Fig. 1, where the current changes from 5 to 15 webers, for this increase of one-tenth of the speed.

As regards the relation of work converted into electrical energy to the work expended to produce it, it appears from the experiments of Mr. Schwendler and Dr. Hopkinson that, with the Siemens machines employed by them, the loss of power was from 12 to 14 per cent., so that if the external resistance of the circuit, *i.e.*, the electric lamp, &c., be so adjusted that half the total work produced appears in the arc, then 43 or 44 per cent. of the total work expended is produced in the arc.

The results arrived at by Dr. Siemens with his latest machine on Wheatstone's principle are:—1. That the electromotive force, instead of diminishing with increased resistance, increases at first rapidly, and then more slowly towards an asymptote. 2. That the current in the outer circuit is actually greater for a resistance of 1½ ohm than for one ohm.

With a current of 30 or 40 webers the horse-power expended was 2·44 h.-p., and the effective work 1·29 h.-p., giving an efficiency of 53 per cent., as compared with 45 per cent. in the ordinary Siemens machine. The maximum energy which can be converted into heat in the machine is 1·3 h.-p. The new machine will give a steadier light with greater economy, and may be driven by a smaller engine.

The Brush Machine.

Among the later continuous current machines are two which promise to be very successful machines. The Brush, with a ring on the Gramme system, with eight divisions or portions hollowed out to receive the coils, the bobbins at opposite ends of a diameter being connected together and to a commutator. When a pair of bobbins passes the neutral point, so that there is no current in it, it is put out of circuit for one-eighth of a revolution, so that the current produced in the other bobbins is not wasted by being sent through the resistance of the two which are producing no current. On the inducing magnets are wound fine wires, offering considerable resistance, which carry the current when the external circuit is open, and keep up the magnetism; but when the circuit is closed, the thick wires on the magnets carry the principal part of the current.

The internal resistance of the machine being about 10½ ohms,

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and the external resistance 73 ohms, there was, according to calculation, a current of 10 webers, and an electromotive force of 839 volts. With these numbers, the effective work on the external circuit ought to be 87·36 of the whole electrical work produced; but, practically, it is only 61 per cent.

The relation of work converted into electricity to the work expended in this machine, is about 73 per cent., whereas with both Gramme's and Siemens's machines, with relatively smaller external resistances, this ratio is about 88 per cent.

(TO BE CONTINUED.)

PARISIAN ELECTRIC RAILWAY.—Under this heading there is an article in the *Révue Industrielle* for the 5th of October. The writer proposes to establish an overhead railway along the streets of Paris, with stations at suitable intervals, which can be reached either by a central staircase leading from a refuge in the middle of the street or by two staircases communicating with the two pathways on each side of the street. The terminus is proposed to be situated at the Arc de Triomphe, and is placed on the level ground, from which the line gradually ascends until it has gained the necessary elevation above the streets. The motive force is to be produced by means of steam engines and Gramme dynamo machines, and is conducted by copper wires along the railway, being communicated to carriages fitted with magneto-electric machines, which in turn drive the wheels of the carriage. The writer indicates various places where the generators might conveniently be situated to serve three different lines, viz., the Madeleine-Bastile line, the Etoile line, and the lignie du Trône. The carriages are to hold 50 persons, and to be of the following dimensions, viz., 8 metres long and 2·50 metres wide, the compartments, of which there are to be five, are to hold ten persons in each, or five a side. The stay of each carriage at each station is to be limited to 30 seconds; reckoning on a speed of 400 metres per minute, and for 30 seconds stoppage at each station, the writer thinks that the distance between the Madeleine and the Bastille would be traversed in about 18 minutes, or half the time which omnibuses now take to do it in. As regards the security of this means of conveyance, the writer mentions that there can be no fear of collision, that in case of the breakage of a wheel or spring the carriage will at once stop of its own accord.

ELECTRIC LIGHT PATENTS IN FRANCE.—In a paper read before the Society of Telegraph Engineers and printed in the *Journal*, a list was given of patents relating to electric lighting taken out in England. What was then done for England has now been done, but more completly, for France, the results being given in two books published by Messrs. E. Bernard and Co., 4, Rue de Thorigny, Paris. The titles of these books are respectively:—(1). "Recueil Général de tous les Brevets d'Invention ayant trait a l'Electricité pris en France depuis le 7 Janvier, 1791, jusqu'a ce jour, dressé par George Fournier." (2). "Manuel de l'Eclairage Electrique, sources et générateurs d'électricité, lamps et régulateurs, éclairage par incandescence et par arc voltaique, division et distribution de la lumière, par Armengaud Aîné." The former of these gives the titles of the patent specification in the briefest manner, thus, p. 108:—142,229, 9 Avril. Larmanjat: Pour un système de moteur électrique. Again, p. 80:—141,995, 29 Mars. M. Edison: Pour des perfectionnements dans les lampes électriques et dans leurs mode de fabrication. The various inventions are classified into six groups. (1) Generators, (2) Electric Light, (3) Electricity Applied to Mechanical Arts, (4) to Chemical Arts, (5) Telegraphs, Telephones, Microphones, (6) Various Applications. The second of these works, though smaller, is more elaborate. It deals only with a certain portion of the electrical patents, and gives a short description of each invention, somewhat as our contemporary the *Engineer* does for all English patents. The first patent noted is that of Nollet, No. 11,647, 26 April, 1851, for improvements in the means of generating electricity, &c., and the last, No. 141,690, on 14 March, 1881, for a new incandescent lamp, &c., taken in the name of a company. Such works as these are exceedingly useful.

THE EASTERN EXTENSION AUSTRALASIA AND CHINA TELEGRAPH COMPANY (LIMITED).

Report of the directors for the six months ended 30th June, 1881, to be presented at the sixteenth ordinary general meeting of the Company, to be held at the City Terminus Hotel, Cannon-street, in the City of London, on Wednesday, the 19th day of October, 1881, at 2 o'clock. The usual statements of account for the half year ended 30th June, 1881, are submitted herewith. The gross receipts, including Government subsidies, have amounted during the half year to £191,580 19s. 8d., against £173,020 0s. 11d. for the corresponding period of 1880, showing an increase of £18,560 18s. 9d. The working and other expenses (including a sum of £21,843 13s. 4d. for cost of repair of cables and expenses of ships), together with income-tax, absorb £55,230 8s. 10d. against £50,384 10s. 6d. for the corresponding half year, leaving a balance of £136,350 10s. 10d. From this is deducted £41,595 for interest on debentures, and contributions to sinking funds for redemption of the Australian Government Subsidy and Manila Debentures, leaving £94,755 10s. 10d. as the net profit for the half year. One quarterly interim dividend of 1¼ per cent. amounting to £24,968 15s. 0d. has been paid for the half year, and it is now proposed to distribute another of like amount, together with a bonus of 1s. per share, payable on the 19th instant, leaving a balance of £34,830 10s. 10d., to be carried forward. Important interruptions have occurred during the half year on the Penang-Madras and Java-Australian cables, the former being broken down from 31st January to the 11th February, and the latter from the 19th April to the 7th May, and from the 1st to the 28th June. The receipts, however, were not affected, as the traffic was transmitted by the alternative cables. In addition to the above, numerous small repairs had to be effected, which required the services of the Company's maintenance ships during a considerable portion of the half year. The Singapore-Batavia cable has for some time past been a source of anxiety to the directors, owing to the increasingly-numerous and costly repairs which have been necessary to maintain the line in working order. After careful consideration it has been decided to replace it with a brass-ribboned cable (580 miles in length) designed to resist the attacks of the marine insect which has been so destructive to the old line. An arrangement has, therefore, been entered into with the Telegraph Construction Company to carry out the work and pick up the existing cable for the sum of £95,000, which it is proposed to pay out of revenue by instalments. By this means, it is believed, a considerable annual saving will be effected in the cost of repairs. The South Australian Government land line, in connection with the Company's system at Port Darwin, has been well maintained during the half year. The directors have to record with deep regret the sudden death, on the 12th ultimo, of their esteemed colleague Colonel T. G. Glover, R.E., who had been in the service of the company since its formation.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Oct. 12.		Business Done Week Ending Oct. 12. Highest.		Lowest.	
Anglo-American	52½,	53	.....	53½	.....	52½
Do. Preferred	82,	83	.....	83½	.....	82½
Do. Deferred	23½,	¾	.....	23½	.....	23½
Brazil Submarine	11½,	¾	.....	11⅝	.....	11
Cuba	9½,	10	.....	—	.....	—
Do. Preference	16,	17	.....	—	.....	—
Direct Spanish	5,	¼	.....	5¼	.....	5
Do. Preference	15,	16	.....	15¼	.....	15¼
Direct United States Cable	10¾,	¼	.....	10¾	.....	10¾
Eastern Telegraph	10¾,	¾	.....	10¾	.....	10¾
Do. 6 per Cent. Preference	13,	¼	.....	13¾	.....	13¼
Do. 5 per Cent. Debentures, 1899	105,	108	.....	—	.....	—
Eastern Extension	11½,	¾	.....	11¾	.....	11½
German Union	10,	¼	.....	10½	.....	10½
Globe Telegraph and Trust Company	6¼,	¾	.....	6 15-16	.....	6¼
Do. Preference	12¾,	¼	.....	12¾	.....	12¾
Great Northern	12½,	¼	.....	12¾	.....	12¼
Indo-European	28,	29	.....	—	.....	—
Mediterranean Extension	2½,	3	.....	—	.....	—
Do. Preference	9½,	¼	.....	—	.....	—
Reuter's	11½,	12½	.....	—	.....	—
Submarine	280,	290	.....	—	.....	—
West India and Panama	1½,	2	.....	2	.....	1¾
Do. 1st Preference	7,	¼	.....	7 11-16	.....	7¼
Western Brazilian	7⅛,	¼	.....	7 11-16	.....	7⅛
West. Union 7 per Cent. 1st Mortgage	125,	130	.....	125	.....	125
Do. 6 per Cent. Sterling Bonds	104,	107	.....	—	.....	—

SUBMARINE CABLES TRUST.—NOTICE is hereby given that the COUPONS of the SUBMARINE CABLES TRUST, due on the 15th inst., will be PAID on and after that date, between the hours of 10 a.m. and 2 p.m., by Messrs. GLYN, MILLS, and CO., at 67, Lombard-street, where the coupons must be left for examination three days previous to calling for payment.

LEWIS WELLS, Secretary.

66, Old Broad-street, London, October 7, 1881.

CRYSTAL PALACE INTERNATIONAL ELECTRIC EXHIBITION.

The Second of the Series of
INTERNATIONAL EXHIBITIONS
inaugurated by his Royal Highness the DUKE OF CONNAUGHT
will be an
ELECTRIC EXHIBITION.
It will be opened in December, and remain open for some months.
The rules, forms of application for space, &c.,
may be had on application to
The MANAGER Crystal Palace, S.E.

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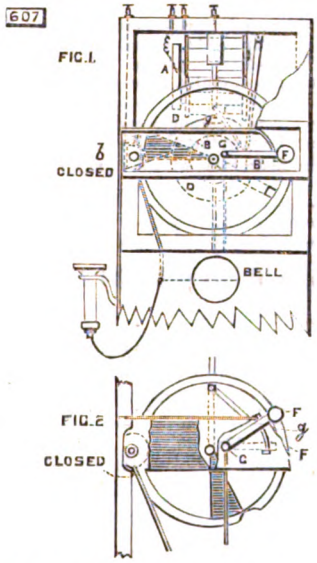
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

607. Improvements in Apparatus for Telegraphic and Telephonic Communication, *P. M. Justice.*—*11th February*, 1881.—*(A communication from J. V. M. Bartelous.)* 1*s.* 4*d.*

The first series of apparatus described in this specification permits of the establishment on a system of three wires of an unlimited number of stations, giving to each the right of calling a central office. The different stations can also be connected with one another or with other lines; for the time being all communication can be stopped except between the caller and called; and also during communication between two persons one wire remains free, either to put the first caller in communication with a third subscriber or to call all the subscribers and put them in communication with another caller. The means by which subscribers are informed that the line is in use are thus described:—Suppose a call to be sent to the central office, as soon as it is produced four successive emissions of the current are sent through the working wire; this has the effect of causing the toothed wheel B B^1, Fig. 1, which is governed by the electro-magnet A acting on a lever, to advance four divisions, or one-twelfth part of the circumference. This effect is produced in all the apparatus, causing the discs to



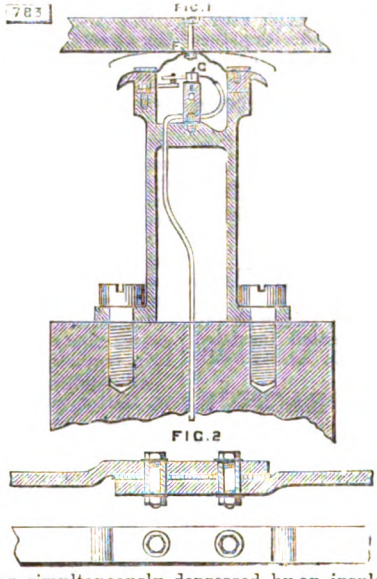
advance one-twelfth of their circumference, and will prevent any other subscriber from pressing his button, *b*, to effect communication; besides, he will be informed of this fact by a special arrangement as follows:—The discs D D are painted in two colours, red and blue; the greater part of the surface is red, except a sector of a one-twelfth part of the circumference, of which the lower radius is horizontal, and which is painted blue. The portion of the front face of the box corresponding to this sector is coloured in the same shade and cross-sectioned. It has the word "closed" on it, cut out in a thin plate; so long as this blue sector is at the back of these cut-out letters the word is hardly apparent, but when the disc turns the red colour shows through plainly, and subscribers will see that the line is in use. They can, however, apply for communication by moving the rod G F to the position G F^1, as shown in Fig. 2, when it will make contact with the metal button *g* and so with the line wire. The second series of apparatus refers to the instillation at any required distance from a central office of an instrument which may be called a distance commutator, and which does away with the necessity for the establishment of an auxiliary office, substituting therefore an automatic station.

774. Electric Lamps, *J. Fyfe.*—*23rd February*, 1881.—*(Not proceeded with.)* 2*d.*

This invention refers to the specification of Abel's patent No. 1,397, 1880 (a communication from Krizik and Piette), and refers to the regulation of electric lamps by means of solenoid lamps.

783. Improvements in Electrical Conductors Applicable to Electric Railways and to Electric Signalling, &c., *J. Perry and W. E. Ayrton.*—*24th February*, 1881. 8*d.*

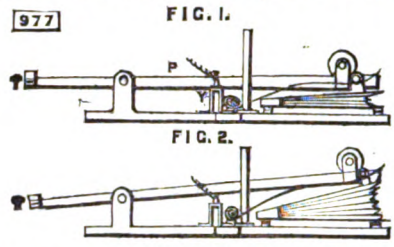
This invention is designed for the better insulation of the conductor in electric railways, and for furnishing an automatic block system without the use of signalmen, and further to give a simple indication of the position of the train at any point of its travel. The method is to have an insulated wire cable placed alongside the railway, or in any suitable position, which is automatically, or at will by a signalman, electrically connected successively to one or more sections of a rail in the neighbourhood of the moving train, the sections of which rail are insulated from one another and earth. In Fig. 1, A B is a copper rod resting on the top of and fastened to a corrugated tempered steel disc D D, which is carried by and fixed to a thick ebonite ring E E by screws. E E is screwed to the top of the circular cast iron box, which is fastened to the sleepers A B, and the steel discs D D are of sufficient flexibility to allow of two or more of the latter



being simultaneously depressed by an insulated collecting brush carried on the carriages of the train. Depressing any of the discs brings stud F—which is mechanically and electrically connected with A B—into contact with stud G, which is electrically connected with the main insulated cable. This connection is made either by means of an insulated wire H H H, or by the cable itself being brought up into the box. To prolong the contact, stud G is supported by a spiral spring, so as to be depressed somewhat by F. The train then receives the current by means of brushes fixed on the carriages from rail A B, and the current, after passing through an electro-motor on the carriages, returns by one or both of the ordinary rails used as the return wire, pieces of flexible wire being attached, if necessary, to the fish-plates to ensure contact. The mode of insulating one section of the conducting rail is shown in Fig. 2. Several methods of keeping the insulations of the various parts perfect in wet weather are likewise described, one of which is to fill the cast iron box with oil. The specification also describes other methods of carrying out the invention, and is accompanied by drawings thereof.

977. Automatic Signalling Apparatus for Use in the Block System and for Protecting Level Crossings on Railway and Tramway Lines, *E. D. Pass.*—*8th March*, 1881.—*(A communication from H. Leblanc and E. V. A. Loiseau.)* 6*d.*

This ievention consists in the combination of various apparatus which together serve as a means for electric and automatic signalling for operating signal discs on railways and tramways, and especially those discs on the Leblanc system. We shall confine ourselves to describing that portion of the apparatus which when actuated by a passing train transmits a signal. In the Figs. P is a pedal supported as shown, one end of which extends about two centimetres above the rail, whilst the other which is weighted bears upon a bellows; this bellows is provided with lugs carrying rollers, under which pass springs which raise it immediately the pedal leaves it. When in the position shown in Fig. 1 the pedal bears against a contact piece Y, and this contact piece when the rail end of the pedal is depressed touches a terminal connected with a current distributor in the signal apparatus, so that an electric current is sent into the latter. Fig. 1 shows the position before, and Fig. 2 after the passing of a train; in order to prevent a series of signals being sent the pedal is only allowed to rise very slowly after being de



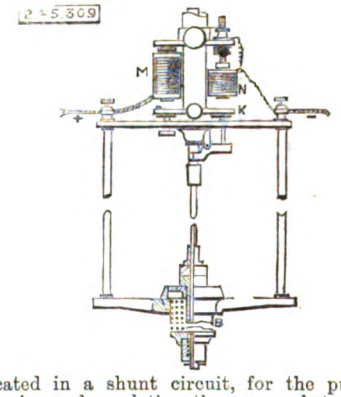
pressed, and thus there is time for the whole train to pass. One of these pedals may be placed at every mile distance, which being in connection with a dial and pointer actuated by an electro-magnet, the pointer may be made to advance one division equal to every mile the train passes over. The remainder of the specification describes the application of this apparatus to the block system and to level crossings.

2217. Electrical Cables for Telegraphic and Similar Purposes, *W. R. Lake.*—*20th May*, 1880.—*(A commnication from P. B. Delany).* 6*d.*

The inventor takes glass or porcelain or similar perforated discs, through the perforations of which the wires are drawn. It may be that the disc has a larger hole at the centre, through which is passed a supporting rope.

245,309. Electric Lamp, *Richard R. Moffatt and Sylvester Chichester, Brooklyn, N.Y.*—*Filed March 21st*, 1881.

Brief.—A magnet is employed to draw down the lower carbon to form the arc. The upper carbon is fed downward by gravity, and its movement is controlled by a compound armature actuated by two magnets, the magnet of less resistance being in the same circuit with the carbons and the arc-forming magnet. The magnet which is of greater resistance is in a shunt circuit, and presents the same poles to the armature as the magnet of less resistance. The armature is composed of a frame having two bars of magnetic material, each extending from a pole of one magnet to a pole of the other. When one magnet is preponderatingly energised the induced magnetism of the armature causes repulsion between it and the other magnet. *Claim.*—(1) In an electric lamp, the combination of the electro-magnets B and M, located in the main circuit, and the electro-magnet N



located in a shunt circuit, for the purpose of forming and regulating the arc, substantially as herein specified. (2) In an electric lamp, the combination of the electro-magnets M and N, the tilting armature K, the carbon rod, and mechanism to check and regulate the feed of the carbon, substantially as herein specified. (3) In an electric lamp, the combination of the electro-magnet M, located in the main circuit, and the electro-magnet N, located in the shunt circuit, said magnets having poles of like nature acting upon the same armature, substantially as and for the purpose specified. (4) In an electric lamp, the combination of the electro-magnets M and N, the tilting armature K, the carbon rod, and the lever brake, constructed substantially as described, so that the action of magnetic attraction and repulsion will act to check and regulate the feed of the carbon, substantially as herein specified.

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ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians,
86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.
Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manu-facturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works,
IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited),
HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia
Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER
WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

NEWTON'S PATENT LAW and PRACTICE,
Price 2s. 6d.
This standard work contains all legal and other information necessary for intending patentees, including Government charges, agency fees, and rules of the Commissioners of Patents.
TRUBNER and Co., Ludgate-hill, and may be obtained at the Office for Patents, 66, Chancery-lane, W.C.

DUNCAN WALLET & CO.,
BONDED STORE AND PROVISION MERCHANTS,
15, BILLITER STREET, LONDON.

Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.
Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.
NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

JOHNSON'S PATENT TRANSMITTER,
IN COMBINATION WITH
BELL'S EBONITE TELEPHONE.
Unequalled for Telephone Exchange or Private purposes.
ALL ROYALTIES PAID.

TASKER, SONS & CO.,
ELECTRIC AND TELEPHONIC ENGINEERS,
SHEFFIELD.

ELECTRIC LIGHT.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy. constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

HARBOROW & CO.,
ELECTRIC LIGHT ENGINEERS
AND
TELEGRAPH INSTRUMENT MANUFACTURERS,
4, CIRCUS STREET, LONDON, W.

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.
Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
Southampton-buildings, Chancery-lane

NEWALL'S PATENT LIGHTNING CONDUCTORS.
Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

SOLE PATENTEES OF UNTWISTED WIRE ROPE.

Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c.
Gilt and Silver Cord for Hanging Pictures. Iron, Steel, and Copper Cord for Clock and Sash Lines, &c.

R. S. NEWALL & CO., LONDON, 130, STRAND, W.C.
LIVERPOOL—36, Waterloo Road. GLASGOW—68, Anderston Quay. Manufactory—GATESHEAD-ON-TYNE.

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West Indies.—The cable between Jamaica and Colon is repaired.

Dividend.—An interim dividend of 2s. 6d. per share is notified by the London Platino-Brazilian Telegraph Company.

Chili.—The Chilian Budget for 1882 estimates the revenue to be derived from the post office and telegraph at 250,000 dollars.

Brazilian Submarine Telegraph Company.—The traffic receipts of this company for the week ending the 7th inst. were £3,259.

Natal Telegraphs.—News from South Africa says that it was rumoured at Pretoria that the telegraph would be removed when the military left.

The Electric Light for Sheffield.—It is reported as probable that the Corporation of Sheffield will adopt the electric light for street lighting ere long.

The Electric Light in Dublin.—The electric light went out the other night, leaving the streets in which it was placed in total darkness. No reason has yet been given for this failure.

Electric Light in Ironworks.—We hear that the electric light is being introduced at the Park Ironworks, Sheffield. The Brush system will be applied in the mills, and Swan's lamps in the draughtsmen's room.

The Electric Light and Military Operations.—The electric light was made use of last week at some night operations carried out at Chatham. Bodies of men were discovered with ease by its aid at over 1,000 yards distance.

Brazilian Submarine Telegraph Company.—The next half-yearly general meeting of this company will be held at the Cannon-street Hotel, on the 28th instant, at 12 o'clock. The report of the directors will be found in another page.

Electric Light at Manchester.—The Manchester, Sheffield, and Lincolnshire Railway Company have given Messrs. Hammond and Company orders to light up their station at London-road, Manchester, with the Brush electric light.

Another Electric Railway at the Exhibition.—It is stated that an electric railway, the carriages of which are designed for the transport of letters and matters for the postal service of large cities, is to be constructed in the Palais de l'Industrie.

Secondary Battery.—M. Rousse has described, in a note to the French Academy, a secondary battery in which he employs for the negative pole a plate of palladium, and for the positive a plate of lead. The liquid employed is one of sulphuric acid to ten of water.

Western and Brazilian Telegraph Company.—The traffic receipts of this company for the week ending October 7th, 1881, were £2,016, after deducting the "fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

Electric Light at Wednesbury.—On Tuesday last a portion of the Patent Shaft and Axletree Company's works was illuminated for the first time by the electric light. The Brush system was used. The trial was satisfactory, and it is probable that other portions of the works will be lighted by similar means before long.

The Electric Light for the East of London.—At the last meeting of the St. George's East Vestry the recommendation of the Paving Committee that steps be taken to ascertain the practicability and possible expense of introducing the electric light for street lighting in some of the public streets in the parish was adopted *nem. con.*

Personal.—The following item of domestic news will, no doubt, be of interest to many of our readers:—Married, on the 26th September, in Christ Church, Zanzibar, by Bishop Steere, William Davies, Superintendent of the Eastern and South African Telegraph Company's Station, Zanzibar, to Frances Lisette, youngest daughter of M. Durand, of Lisbon

Prices.—The prices as quoted this week are:—For gutta percha per lb.:—Good to fine, 2s. to 4s.; low to medium, 3d. to 1s. 9d. For India rubber, per lb., fine Para, 3s. 4d.; negrohead, 1s. 11½d. to 2s.; central American, 1s. 6d. to 2s. 2½d. Assam and Pegu, 8d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 5d. to 2s. 2d.

International Electrical Exhibition at Paris.—The Commissioner General of the Exhibition has issued a circular stating that it is possible the Exhibition may be closed on the 1st of November next. The *Ville de Paris*, however, thinks it quite impossible that the Exhibition can be closed by that time, for many reasons, which are chiefly personal, and do not, therefore, concern us.

The Telephone in Sheffield.—After a severe competitive trial between the Johnson-Bell Telephones as offered by Messrs. Tasker Sons and Co., and the Gower-Bell Telephones as offered by the Post Office, the Sheffield Corporation have contracted with Messrs. Tasker for the adoption of their telephones for five years in the police and fire brigade stations in place of the Wheatstone ABC hitherto in use.

The Telephone in Portugal.—The Direction-General of Posts, Telegraphs, and Lighthouses in Portugal has put up for public competition, until the 8th November, the construction and working of the telephonic circuits in the cities of Lisbon, Oporto, and others, according to the specification and conditions published in the *Journal Officiel*, No. 203, of the 10th of September last, which may be seen at the Portuguese Consulate, London.

Electric Light at Aberystwith.—At a recent meeting of the Aberystwith Town Council the mayor and another councillor gave notice of their intention to bring before the council at their next meeting the question of introducing the electric light for public illumination. It was stated that the overflow from an old reservoir was sufficient to generate the necessary power, and that the lighting of the town could thus be undertaken at a moderate cost.

Water Power at Poole.—Mr. Ponton, surveyor, of Poole, has sent a communication to the mayor of that town in which he estimates the power to be obtained from the rise and fall of the tides in Poole Harbour to be equivalent to 30,000 horse-power per 24 hours. He proposes to use a portion of this vast power to generate electricity for lighting the town of Poole, which needs a little more light, being, we believe, still attached to oil lamps as a means of street illumination.

Dilatoriness.—At a recent meeting of the Strand Board of Guardians, the question of telegraphing for the ambulance in order to remove small-pox patients to the hospital ship "Atlas" off Deptford cropped up, and the senior relieving officer of the board stated as his experience that often three or four hours elapsed between the inquiry by telegraph to the Deptford Hospital and the receipt of the reply. A guardian said that if this was the case, it was a very great shame that the telegraphic arrangements should be so dilatory.

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BUENOS AYRES GREAT SOUTHERN RAILWAY.—In the report of the directors of this railway company for the half year ending 31st of June, 1881, the receipts from telegraphs are stated to have amounted to £1,607, against £1,678 for the same period of 1880. The general manager of the line says, however, that no fair comparison of the results of the half year ending 31st June, 1881, as compared with the corresponding period of 1880, can be arrived at, in consequence of the disturbing influences which have operated.

QUICK WORK AT LEEDS.—On the occasion of the recent visit of Mr. Gladstone to Leeds the resources of the Leeds telegraph department were heavily taxed. On the first day 447,274 words were transmitted, and on the second day 207,279, or a total of 654,553 words. These were all sent from one office. To meet the extra work fifteen extra Wheatstone automatic instruments were brought into use. The weather was very unfavourable, being rainy, so that the telegraph staff of Leeds may be congratulated on the result of their work.

THE ELECTRIC LIGHT FOR CHELSEA.—In his annual report to the vestry, which has just been issued, Mr. G. H. Stayton, the surveyor, says:—"The question of the electric light still continues to receive my best consideration, but I am yet unable to recommend a trial of the system, as I cannot obtain any definite or reasonable terms for its adoption in Chelsea. It is, however, making considerable progress, and the results of the experiments which are now being made in the City of London and elsewhere will be quite as valuable to this parish as if a large expenditure for a similar trial had been incurred by your vestry."

LECTURES AT OXFORD AND CAMBRIDGE.—The following lectures have been arranged for at Oxford during the Michaelmas term, in the University Museum. Professor Clifton on Wednesday and Saturday, on "Terrestrial Magnetism;" Mr. Hayes on "Electrostatics from a Mathematical Point of View." Instruction in practical physics will be given daily in the Clarendon Laboratory, under Professor Clifton, and Messrs. Stocker and Heaton. At Balliol College, Mr. Dixon will lecture on "Elementary Magnetism and Electricity." At Cambridge Lord Rayleigh will give lectures on "Electricity and Magnetism."

WEST INDIA AND PANAMA TELEGRAPH COMPANY.—At a meeting of the board of the West India and Panama Telegraph Company (Limited), held this week, it was resolved to recommend to the shareholders, at the approaching general meeting, the declaration of a dividend of 3s. per share on account of arrears of dividend on the first preference shares to June 30, 1881, carrying £8,708 8s. 2d. to the current half-year. The estimated traffic receipts of this company for the half-month ended October 15th were £1,732, as compared with £1,090 in the corresponding period of 1880. The July receipts, estimated at £4,116, realised £4,152.

THE BRUSH LIGHT.—It is stated that 1,855 of these lights have been erected in the United Kingdom, as against 15,000 in America. Messrs. Hammond and Company, who have recently become so active in introducing this light, are considering the advisability of following the lead of America in another direction, viz., the introduction of central stations, whence electric light mains can be laid as desired, similar to gas pipes, thus minimising the cost to individuals. We suggested that this should be done a long time ago, and shall be glad to hear of its accomplishment. A successful experiment of the kind would do more to bring the electric light into general use than all other experiments combined.

ELECTRIC LIGHT IN COAL MINES.—We extract the following from the preliminary report of H.M. Commissioners appointed to inquire into accidents in mines:—"We have been instrumental, through the liberal aid of Mr. Crompton and his partners, in having the electric light introduced experimentally by the Stanton Coal and Iron Company in their Pleasley Colliery, near Mansfield. Thirty of Swan's lamps were placed, some in the inset, some along the main road, and several in the long-wall face. An admirable illumination was obtained, but further experiments, and a full examination into all details connected with its application, are needed before it can be decided whether the electrical illumination of workings is practically achievable."

UNDERGROUND TELEGRAPHS IN GERMANY.—The system of underground telegraphy in Germany which was completed some few months ago, and the progress of which we have noticed from time to time, consists of 18 lines, connecting 221 towns. Ten of these lines were laid by Messrs. Felten and Guilleaume, 101, Leadenhall-street, London, and Mullheim-on-Rhine, Germany, the remainder by Messrs. Siemens and Halske, of Berlin. The conductors in the 3,394 miles of cable have a total length of 23,213 miles. The weight of the materials consumed in manufacturing these cables was 12,825 tons, consisting of 10,165 tons of iron, 823 tons of copper, 837 tons of gutta percha and hemp, and 383 tons of asphalte. In the crossing of rivers 70 cables were required. The total cost of the work was 30,200,000 marks, or £1,510,000.

CITY AND GUILDS OF LONDON INSTITUTE.—The programme of technological examinations has just been issued. Among other alterations the subjects of "Electric Lighting and Transmission of Power" and "Electrical Instrument Making" have been added, and have been classed with "Telegraphy" as branches of electrical engineering. The examiners in electrical subjects are: G. Gore, F.R.S., for electro-metallurgy; W. H. Preece, F.R.S., and Professor W. E. Ayrton, F.R.S., for electrical engineering. The examination papers for last year are given at the end of the programme, which also includes a syllabus of each subject. Our young readers must not forget that they have an excellent opportunity for becoming acquainted with electrical subjects in attending the classes of Professor Ayrton, instituted by the City Guilds Institute at Cowper-street.

ELECTRIC LIGHT FOR THE HOUSE OF COMMONS.—The following paragraph has appeared in several provincial papers lately:—"Gas will still be the luminant in use in the House of Commons next session. The glamour the electric light cast upon the scene when it was tried, with its cold, steel-blue rays, was too uncomfortable to leave any chance of its superseding the old arrangements. As a fact, the House of Commons has the reputation of being more efficiently lighted than any other hall of the same size in Europe. The only serious defect of the system has been that the heat under the galleries, where there are small gas-jets, was excessive. The electric light, when small burners were introduced, succeeded admirably in remedying this, however, and though nothing has been decided on it is not unlikely to be introduced for this supplementary object perhaps before next session."

ELECTRIC LIGHTING AT THE MANSION HOUSE.—In answer to the recent invitation for tenders for lighting the saloon and the Egyptian Hall at the Mansion House by electricity, the General Purposes Committee of the Corporation received seven replies. We believe the committee have, after due consideration, resolved to submit Mr. Crompton's system to the Court of Common Council for their approval. The terms of

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he contract are, to light the saloon and Egyptian Hall for 100 nights at £425, being £300 for the apparatus and £125 for working expenses. If, at the end of twelve months, the Court decide to purchase the apparatus, they will be charged £1,200, less the £300 paid for the year's lighting. Mr. Crompton's arc lights will be used in the saloon and Egyptian Hall, as follows:—Two arc lamps over the ground glass in the centre of the saloon, and one in another part of the room as a stand-by, in case these two should not be found to be of sufficient power, and four arc lamps in the Egyptian Hall. Besides these, Swan incandescent lamps will be used here and there, as required.

International Meeting of Electricians.—The first meeting of the International Meeting of Electricians was held on the 8th of October, at the Hotel des Chambres Syndicates, under the presidency of M. Fontaine. It is stated that about 200 persons were present. The meeting is to be known in the future by the title of Réunion Libre. This alteration in the title is a concession to the wishes of M. Cochery, the Minister of Posts and Telegraphs. Messrs. Warren de la Rue, Mathieu, and Fontaine were nominated honorary presidents, and M. Armengaud president. The future meetings will be held in the Palais de L'Industrie. The Réunion has been divided into four sections, each of which has been entrusted with the study of one of the four following subjects:—"Transmission of Power," M. Boitelle president, M. Leblanc secretary; "Electric Lighting and its Distribution," president M. Niaudet, secretary M. Napoli; "Telephony, Railway Signals, and Electric Clocks," president M. Marché, secretary, M. Berthon; "Electro-Chemistry," president, M. Love, secretary, M. Bourdin.

The Swan Lamp for Trains.—An experiment was satisfactorily carried out last week, having as its object the trial of the Swan incandescent lamp as an illuminant for trains, combined with the Faure secondary battery. The trial was made by the London, Brighton, and South Coast Railway on one of their Pullman cars attached to a special train running between Victoria Station and Brighton. The car was fitted with twelve Swan lamps and thirty-two Faure cells. On the journey down the lights were only used in the tunnels, but on the return journey, which was made in the evening, the lights were used over the whole distance. Among those who were in the special train were:—Mr. J. P. Knight, general manager of the company; Mr. Houghton, telegraph engineer; Mr. H. S. Roberts, manager; and Mr. Miller, secretary of the Pullman Car Company; Mr. F. A. Pincoffs and Mr. Lachlan, of the Faure Accumulator Company. We believe that the lamps gave satisfaction, and it is probable that the new Pullman car train, which is about to be placed on the line to run between Victoria and Brighton, will be fitted with the Swan lamp throughout.

Crystal Palace International Electrical Exhibition.—The following is a list of the honorary council of advice, in connection with this exhibition, viz:—James Abernethy, Esq. (President Institute Civil Engineers); Professor W. Grylls Adams, F.R.S.; Sir James Anderson; Professor Ayrton, F.R.S.; Lieut.-Col. Bateman-Champain, R.E.; Sir Henry Cole, K.C.B.; William Crookes, F.R.S.; Alderman Ellis (Lord Mayor Elect); H. G. Erichsen, M.S.T.E.; Henry C. Forde, M.I.C.E., S.T.E.; Captain Douglas Galton, C.B., F.R.S.; Dr. Gladstone, F.R.S.; Colonel Gouraud, W. Grantham, Q.C., M.P.; C. Hutton Gregory, C.M.G., C.E.; Alderman and Sheriff Hanson, Sir John Hawkshaw, C.E., F.R.S.; John Holms, M.P.; Dr. J. Hopkinson, F.R.S.; Professor Fleeming Jenkin, F.R.S.; S. Laing, M.P.; Sheriff Ogg; Sir A. J. Otway, Bart., M.P.; Sir E. J. Reed, C.B., M.P.; B. Samuelson, M.P.; J. S. Sellon; Dr. C. W. Siemens, F.R.S.; W. Spottiswoode (President Royal Society), Sir Henry Tyler, M.P.; Charles V. Walker, F.R.S.; Sir E. Watkin, Bart., M.P. The following have consented to act as directors:—Mungo M'George, Esq., chairman; Major A. G. Dickson, M.P., deputy-chairman; John M. Douglas, Esq.; Jonas Levy, Esq.; Dr. Reginald Read, Charles Schiff, Esq.; David Thomson, Esq. Major S. Flood Page is manager.

The Late Gale.—The disastrous gale of Friday, the 14th of October, will probably linger long in the memories of telegraphic officials. From every side come reports of wires down, and the damage is not confined to our own shores, but extends to the Continent as well. If any testimony were needed as to the wonderful utility of the telegraph it would be found in the absolute paralysis which sets in, in public and mercantile affairs, directly there is a breakdown. On the day following the gale all the daily newspapers had a note bewailing the loss of their continental and country news through the failure of the wires. On the Stock Exchange no business to speak of could be done, owing to the same cause. The parts of Germany where the laying of the underground cables has just been completed furnish a practical illustration of the benefits of this system, owing to its exemption from the disastrous effects of the gale, news from Berlin stating that in these parts telegraphic communication was entirely uninterrupted. In England the breakdown is reported to have been one of the most complete that has been experienced for some years. One illustration of the roundabout expedients that had to be adopted for forwarding messages will suffice to show this. Telegrams from Bolton had to be sent to Manchester, and forwarded thence by train to Birmingham and other places before they could be wired.

Electric Lighting, &c., Acts for 1881.—The following measures contain provisions for the supply of electric lighting in public places only:—The Barrow-in-Furness Corporation Act contains clauses enabling the Corporation, during a period of ten years, to supply light, heat, and motive power by electricity. For this purpose £20,000 may be raised, repayable within the ten years. The usual clauses for the protection of the Postmaster-General are inserted in this and the other electric lighting Acts.—The Bingley Water and Improvement Act authorises the Commissioners to produce and supply light, heat, and motive power by electricity within their district during a period of ten years. For this purpose the sum of £10,000 may be raised, repayable in ten years.—The Birkenhead Corporation (Gas and Water) Act provides that during a period of five years the Corporation may light the streets by electricity, "or other like agency."—The Irvine Burgh Act contains provisions for the supply by the Corporation of light, heat, and motive power by electricity, during a period of five years.—The Stalybridge Extension and Improvement Act contains clauses enabling the Corporation to supply light by electricity, for any purposes for which under their Act of 1828, they may supply gas. These powers are only to be exercised during a period of five years. The Corporation are authorised to borrow £10,000 for this purpose, repayable in ten years.—It is also stated that the Corporation of Manchester will promote a Bill next Session for municipal improvements, which will include powers to use electricity for street lighting.

Electric Light at the Opera, Paris.—The Paris correspondent of a daily contemporary writes as follows of the lighting of the opera house by electricity:—"The gala performance given at the opera last night (Sunday) in honour of the scientific men who have been attracted to Paris by the

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Electrical Exhibition and Congress was a greater success on the stage than in the house. The fact is that there had not been time enough to organise the necessary apparatus for the greater number of the lights that were to be tried, and even those which were exhibited could only be put into order a quarter of an hour before the curtain rose. Nevertheless they made a goodly show. The famous staircase, for instance, looked splendid in the radiance of the Brush light, and the *coup d'œil*, when the broad 'escalier' was lined by the Garde Republicaine as the President of the Republic arrived, was really extremely fine. The 'loggia,' thanks to electricity, was light as day, and the gorgeous 'foyer' looked by comparison heavy and dull. The Jablochkoff lights round the ceiling of the auditorium did not harmonise with the gas in the 'salle' and on the stage, and the most successful feature of the experiment was unquestionably the lighting, by means of the Jaspar method, of the long refreshment room. In this Belgian invention the light is reflected from the lamp, which is itself hidden from view, on a broad white disc suspended from the roof, thence to be refracted all over the apartment. All glare is thus avoided, and the light is exceedingly pleasant to the eyes. But the waste must, of course, be considerable, and the cost, I presume, proportionately great."

Telegraphs in Germany and the Recent Gale.—*The Times'* Berlin correspondent, telegraphing from that place on the 16th inst., says:—"Overland telegraph communication between Berlin and all the chief towns of Germany was interrupted, but the subterranean net of cables, which was but lately completed, kept the capital on speaking terms with the rest of the Empire except Munich, Bavaria alone not yet having established a system of sunken wires. On Saturday morning, however, telegraphic communication had been restored with all the chief towns of Europe save London." Here is striking testimony to the advantages of the underground system. How long will it be before the English correspondent of a foreign paper will be able to telegraph in similar terms? Surely the cost of the repairs necessitated by these gales, which do not come once a year only, will have some effect on the authorities at the General Post Office. "A Country Stockbroker," writing on this subject to the abovementioned paper, says:—"Will you kindly permit me to suggest, through your columns, that the Government should, as early as possible, take steps to obviate for the future the great inconvenience the country has to-day been put to by a practically total suspension of the telegraphic service through the damage to the wires by the gale of wind now raging? The remedy is, of course, underground lines, and if a comparatively poor country like Germany can afford £1,500,000, as she has recently done, for that purpose, surely we can do so. As it is, we are completely at the mercy of any moderately severe gale, and in these days, when business is principally transacted by wire, the loss on the year by several days' suspension (not to speak of cost of repairs) must be enormous and not to be compared with the expense of a subsidiary system of ground lines. If necessary, let an extra charge be made for transmission by such lines; but the present state of things is unworthy our age of progress."

Telegraphic Communication with Lighthouses.—In pursuance of a requisition signed by 1,200 citizens of London a public meeting, convened by the Lord Mayor, was held at the Mansion House, on Tuesday last, for the purpose of representing to Her Majesty's Government the urgent necessity of establishing telegraphic communication between lighthouses and lightships and the shore, so as to prevent great loss of life round the coast in vessels shipwrecked or in distress. The Lord Mayor, M.P., who presided, expressed the pleasure it gave him to call such a meeting, for the question was one not of merely local interest but of national concern. Apart from the incidental desire of the men who so gallantly spent their days on the lighthouses and lightships on the coast to be placed on terms of intercourse with those near and dear to them on shore, there was the far greater consideration that most of the vessels in distress and the wrecks happened to be at least 10 or 12 miles distant from the mainland; that rockets and guns were now the only available means of communication, and that these entirely failed in fogs, snowstorms, and other atmospheric disturbances. He could hardly imagine any more desirable end to attain than the placing of the lighthouses and the surrounding lightships in instant communication with the shore, by which means a vast amount of property and great numbers of lives might be saved. The lighthouses were admirably managed by the Trinity House and the lifeboats on shore were ever ready for duty, but lives were lost and goods sacrificed by the absence of communication and the loss of time that now elapsed in observing the signals of distress. He hoped the result of that meeting would be to ask the Board of Trade to establish those means of communication, and he knew that the Government would be supported in the attempt and in the cost by the whole mercantile and shipping community as well as by those who were continually harrowed by the daily recurring accounts of shipwrecks and loss of life around our coasts. The Rev. John Gilmore, vicar of St. Luke's, Lower Norwood, moved, as the first resolution, that the meeting was convinced that there was annually a great loss of life and property arising from the want of sufficient communication between the several lighthouses and lightships and the harbours and lifeboat stations round the coast of Great Britain. He spoke, from an experience of eighteen years as a minister at Ramsgate, to the great need of the communication suggested, and said that many rescues of lives and vessels might have been effected if instant help had been forthcoming, instead of being rendered in the midst of terribly adverse and later conditions of tide, sea, and atmosphere. In proof he narrated harrowing instances connected with the losses of the vessels "Deutschland" and "Indian Chief," with many lives. Mr. E. Leigh Pemberton, M.P., seconded the resolution, saying that, at present, lighthouses and lightships only warned vessels where they should not go, but the object of that meeting was to go much further, and to take steps to rescue vessels and lives from danger, consequent on the rocks and quicksands upon and into which they had fallen in spite of those warnings. A gentleman in the meeting essayed to advocate some particular contrivance of his own in the matter, but the Lord Mayor silenced him, saying they were not met there to dictate to the Government what particular steps to take, but to lay the matter fairly and impartially before them and leave them to do what was right. The motion was then carried unanimously. Mr. E. J. Hobbs, of Ramsgate, proposed, and Mr. Shippey seconded, the next resolution, which asserted that it was a matter of urgent necessity that electric communication should be established between the various lighthouses and the shore in order that more speedy intimations of vessels wrecked and life and property in peril might be afforded to those ready to come to the rescue. This also was adopted, and the Lord Mayor was requested to forward the resolutions to the Government, and to ask them to take immediate practical steps to carry into effect the required communication. A hearty vote of thanks to the chief magistrate closed the proceedings.

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THE ELECTRICAL EXHIBITION AT PARIS.

Miscellaneous Exhibits.

Monnier's Automatic Methanometer.

The automatic methanometer—or analyser of fire-damp—of M. Denis Monnier, professor of chemistry at the University of Geneva, shown in the Swiss section, is not only an alarm-giver of fire-damp, but gives also, at a distance, an automatic and quantitative analysis of gaseous mixtures containing hydrogen and its carbides. It consists of two separate instruments—(1) the analyser; (2) the receiver.

The analysers are placed in the galleries and workings of the mines, while the receiver is in the office, or wherever desired, under the eyes of the manager or engineer. The analyser periodically, say each hour, transmits to the receiver the proportion of fire-damp between 1 and 9 per cent. that is mingled with the air of that part of the mine in which it is placed. The proportion of 9 per cent. is that at which an explosion may take place. It is important that the receiver should be so placed as to be constantly before the eyes of the manager, because he can himself arrange the contacts which regulate the sounding apparatus or other alarm when the mixture of gases has attained dangerous proportions. He will give the necessary orders, and the apparatus enables him at a distance to follow the effects of the attempts to ventilate the dangerous part. The reaction which is utilised in the methanometer is the decomposition of methane—marsh gas—in presence of an excess of ordinary air under the influence of a high temperature, such as an induction spark or incandescent platinum, into products condensable or non-condensable. The condensation is shown by a change of height in the column of mercury in the manometer. It was formerly supposed that this decomposition was indicated by the following equation:—

$$C H_4 + O_4 = C O_2 + 2 H_2 O.$$

M. Berthelot has demonstrated that the reaction is more complex, and that other compounds, such as naphthaline, are formed, and M. D. Monnier, has confirmed the accuracy of M. Berthelot's investigations. He obtained from the burning for three months of pure marsh gas small crystals, of which the fusing point was 79 deg., burning with a sooty flame, insoluble in water, and very soluble in alcohol.

The analyser is represented in Fig. 1. The different parts of this apparatus are mounted on a strong plate of bronze, upon one of the sides of which are the burner, the manometer, and the pendulum; on the other, the clutching gear. The whole is enclosed in a closely fitting case. The burner or combustion chamber A, Fig. 1, is a little receiver, with a platinum wire of small section traversing its longest axis. It communicates, as shown, with the manometer D, made of glass, and containing mercury. The two side tubes issuing from the combustion chamber are of glass, upon which are fixed tubes of india rubber, first connected so as to pass under the bar E; then, one to the bellows actuated by the movement of the sounding apparatus, the other carried through a hole in the case to take in the air of the mine. The clutching apparatus, to close the india rubber tubes consists of an electro-magnet, covered with wire of large section, and a soft iron armature in the form of T. The lower part of the armature is guided by two pins. When the current passes into the electro-magnet Y, this piece T, and consequently the bar E which compresses the tubes resting upon the metallic plate N, is drawn downwards. This plate is not fixed, but is mounted so as to take a position parallel with a knife-edge upon the bar, and is also grooved to insure the hermetic sealing of the tubes between this edge and the plate. The end of the lever E is bevelled, and stops against a conical piece of steel fixed upon the rocking armature of the electro-magnet X, used to disengage the tubes. This conical piece is under the tension of the spring shown in the figure, which at the same time insures the withdrawal of the armature of X. The india rubber tubes under the rod E spring open when not under pressure. In this position the end of the bevel of the rod is towards the top of the cone, but when the current passes into the electro-magnet Y, the rod being attracted, raises the cone, passes its base a little, and is stopped by the detent of the spring. The contacts are distributed by a disc fixed upon the wheelwork of the pendulum; they serve to engage and disengage the tubes, and to complete the circuit for raising the platinum to incandescence.

The designer is satisfied by a number of determinations that the manometric indications given are always similar under similar conditions, taking into account the exact period during which the wire is maintained at a bright-red heat, the temperature of the surrounding atmosphere, and the height of the barometer. The latter has little influence on the results obtained; temperature has more, but this varies little in the positions in which the apparatus is intended to be used. Suppose the analyser to work in a gallery where the temperature varies from 30 deg. to 40 deg. The average is 35 deg., for which the instrument is regulated, and the observer proceeds to determine the height of the mercury column, which shows a mixture of 5 volumes of marsh gas to 95 volumes of air. This height divided by five gives the height corresponding to 1 per cent. of marsh gas. The experiment should be repeated with 2, 4, 6, 8 per cent. of gas to verify the determination. Suppose this height to be 4mm. Starting from 0mm., nine platinum wires are fused into the manometer tube at distances corresponding exactly to the height of 4mm. The manometer thus prepared is ready to act with its combustion chamber. We see then that the apparatus is graduated empirically, and not according to the equation given above. M. Monnier prefers to graduate his apparatus with pure marsh gas, even when it is to be used in places where other gases predominate, the aim being to avoid accidents, and not to obtain exact results.

When the apparatus is intended to analyse quantitatively the mixtures produced by the leakage of illuminating gas in public buildings, theatres, &c., the inventor uses an indicator with ten divisions, 0 to 9, each platinum wire from the manometer being connected directly to one of the divisions, thus necessitating ten wires for indications of 1 to 9 per cent. It is hardly necessary to say that the regulation of the apparatus should now be made with coal gas. In theatres, &c., it is unnecessary to consider much the number of wires between analyser and receiver, as the distance is insignificant; but in places where the distances are considerable the number of wires requires consideration, as their cost is a large item in the installation. M. Monnier has given attention to these facts, and has designed apparatus whereby one transmitter and one receiver work with eight, ten, and even twelve analysers and only one line wire.

The action of this transmitter is briefly as follows:—The nine platinum wires from the manometer D, Fig. 1, are connected with an equal number of platinum plates insulated in ebonite and arranged in the form of an arc, Fig. 1, a^1, b^1, . . . h^1. At the centre of the arc is a ratchet wheel, G, furnished with pawls and carrying a contact-piece, B, which passes from plate to plate at each movement of the wheel corresponding to one tooth. The mercury of the manometer is in permanent contact with one of the poles of the battery. The ratchet wheel and arc, electro-magnet C—which actuates by its armature a lever, L, and thus the pawls—are connected to the other pole of the battery. When the mercury of the manometer reaches the first wire, *a*, the circuit of the battery is closed. The current then passes by the first plate, a^1, the contact-piece B, the ratchet wheel, and the electro-magnet C; the magnet attracting its soft iron armature, L, makes the wheel advance by one tooth, the contact B comes to the second plate b^1, and the circuit is again open. This movement of L is utilised to put the current to line by means of two springs, H I.

When the mercury reaches the second wire, *b*, the same movement is repeated, and so on till a contact made by the wheelwork closes the circuit of the electro-magnet M, which, reacting upon its armature, releases the two pawls F and O. The disc becomes free, and influenced by the weight

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P returns to its normal position, being stopped by the stop Q.

The central receiver is almost identical with the transmitter, which has been described, but is more simply constructed, inasmuch as the nine plates of the transmitter

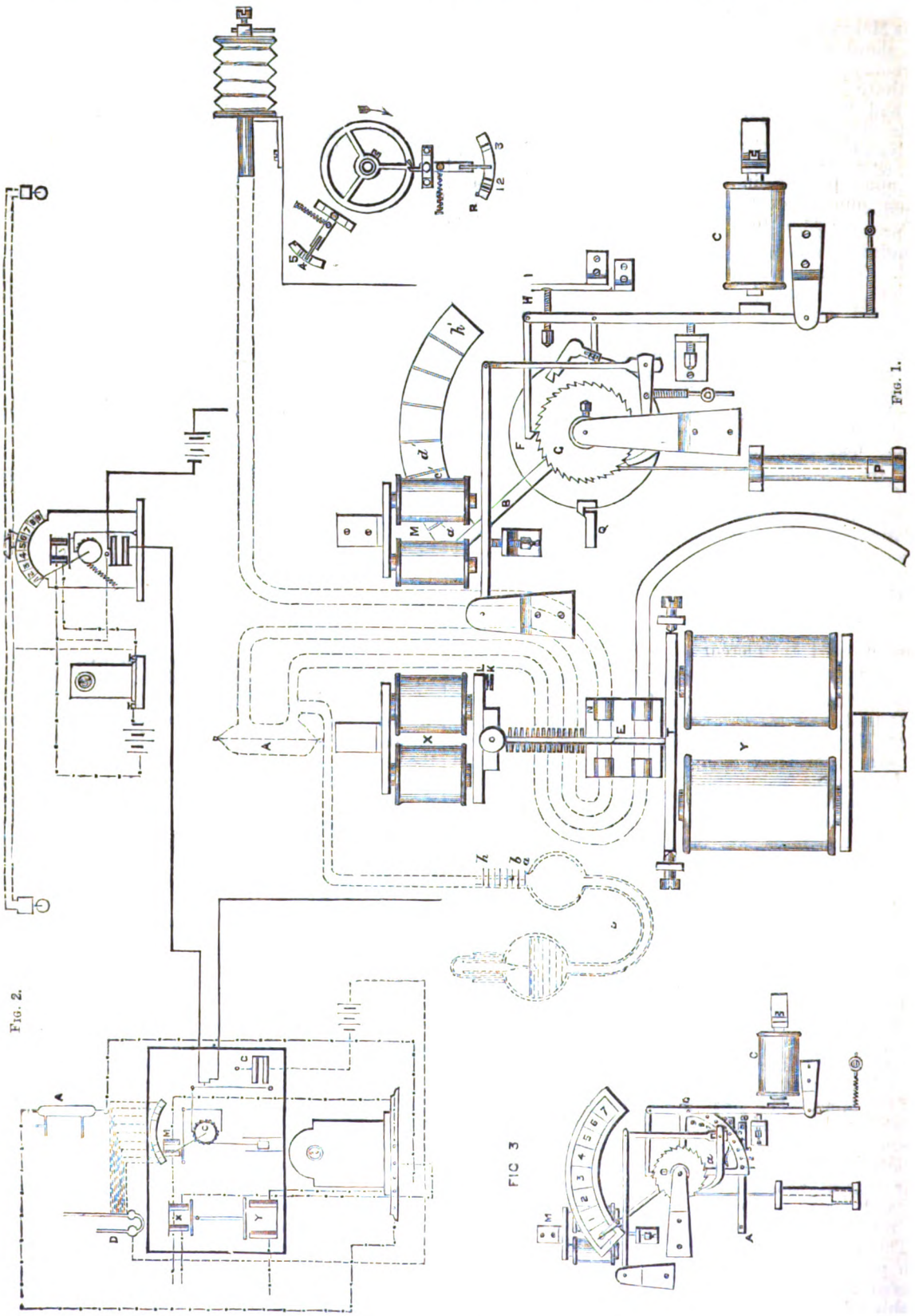

Fig. 1.

Fig. 2.

FIG 3

which serve to distribute the contacts are replaced by a simple enamel dial divided into as many parts as indicate 1 to 9 per cent. of fire-damp. The ratchet wheel of the receiver carries underneath and opposite to the pointer a brass plate in the form of a quarter circle *a b c*. This arc is pierced with as many holes as the dial has numbers; these holes being for the purpose of receiving a contact peg. A spring (Fig. 3) A B, carries a wider piece of metal in the centre to insure contact with the peg, when the latter passes through one of the holes. The numbering of the openings in the quarter circle correspond to the sections of the dial. Thus, if the pointer indicates a certain division of the dial, the corresponding hole ought to place itself above the contact of the spring A B. It suffices, then, for the manager or engineer to place the peg in the hole corresponding to the proportion of fire-

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damp beyond which he does not think the mine safe, to set a bell in continuous action when such proportion is reached. It is this part of the receiver which constitutes the alarm. The receiver acts in the following manner:—When the contact B —Fig. 1—of the transmitter passes from the first to the second plate, viz., from *a* to *b*, Fig. 1, the current is put to line by the contacts H I. The electro-magnet C, Fig. 3, attracts its armature, and the pointer originally placed over O passes to the section No. 1, which indicates 1 per cent. of fire-damp.

At the end of five minutes, the time fixed for the analysis, the pendulum of the receiver closes the circuit of the coil M, Fig. 3, and returns the pointer to 0, by the same mechanism as returns the contact of transmitter to its normal position. The bellows acts six consecutive times in each hour, the air of the mine passing in and out of the tube in the box a similar number of times. This operation is sufficient in great measure to renew the air of the small combustion chamber; about one minute afterwards, the knife, which is placed on the side of the disc which influences the working of the pendulum—see Fig. 1—comes into contact with a platinum lever, and causes it to traverse a circular disc of ivory on which are rivetted three platinum contact pices, 1, 2, 3. The first contact, being of short duration, closes the circuit of the coil Y, and compresses the india rubber tubes; the second sends the current into the platinum wire of the combustion chamber A. This contact lasts for fifteen seconds, the lever then takes one minute to reach the third contact, which again causes incandescence of the wire for fifteen seconds. The knife at the edge of the disc lets go the lever, which, being influenced by a spring, is stopped against R, and is thus once more in its old position.

It takes five minutes more for the knife to reach the second circular disc of ivory, and it is during this time that the transmitter works; this second disc is furnished with two platinum contact pieces. The first, 5, closes the circuit of the coil X, and effects the compression of the india rubber tubes. The movement of the armature of this magnet is utilised to break the line circuit until the mercury of the manometer has returned to its ordinary level—Fig. 1, K L. The second contact, 4, sends the current into the electro-magnet M, and moves the pointer B to the left side of the first plate A.

The reason for raising the platinum wire twice to incandescence for fifteen seconds, with an interval of one minute, is as follows:—The wire being suddenly raised to a very high temperature dilates instantaneously the gas in the combustion chamber; one part of this gas escapes combustion, being driven back into the manometer. During the minute allowed for cooling, this gas returns into the combustion chamber, where its combustion is almost entirely completed. By compressing the india rubber tube which unites the combustion chamber to the manometer, complete combustion of the gas is obtained by raising the wire to incandescence once only; as, however, it is feared that the presence of an explosive mixture of gas might break the vessel, the communication between it and the manometer is left open. The latter is so arranged that the mercury cannot be forced out of it, even if the combustion chamber should be destroyed by an explosion. To work twelve analysers in one line the following are the arrangements:—The pendulums of the analysers should be set five minutes in advance of one another; the regulating pendulum of the central receiver will return them to 0 every five minutes. Each analyser carries a dial which permits of its being put to the exact hour, this being effected by a special apparatus placed in the outer part of the box covering the analyser. By consulting the time by the central pendulum the engineer can tell the part of the mine in which the analyser which is about to send its indication is placed. Fig. 2 gives an illustration of the distribution of the currents. In the analyser here given the letters are the same as in Fig. 1. The wires to the left compress and release the india rubber tubes, and cause the contact of the ratchet wheel to return to the side of the first plate. The wires to the right belong to the transmitter and the line. In the receiver the wires indicated by full lines distribute the current which liberates the india rubber tubes from compression, the others the current which operates the alarum bells.

CORRESPONDENCE.

MAGRINI'S TELEGRAPH.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your issue of the 15th October, under "Slip," I find a reference to Magrini's Electro Magnetic Telegraph, exhibited in the Italian Section of the Paris Exhibition, with a request that any information relative to Magrini, or his apparatus, may be forwarded to you.

It may not be uninteresting to your readers to know that there are no less than fifty works by Magrini in the library of this society, and that his Electro Magnetic Telegraph forms the subject of an interesting and fully illustrated pamphlet, published in 1838, the following being the full title:—

"Telegrafo Elettro-Magnetico Praticabile, a grandi distanze immaginato ed eseguito da Luigi Magrini," 86 pp. and plates. Venezia, 1838.

As the library of the society has been generously thrown open by the council to electrical students and others, and is open to eight o'clock in the evening on Monday, Tuesday, Wednesday, and Friday, for the convenience of those unable to attend in the daytime, the work now referred to, and any other in the library, may be consulted by those interested.—Yours, &c.,

A. J. FROST, Librarian.

Society of Telegraph Engineers and of Electricians, 4, Broad Sanctuary, London, S.W., 18th October, 1881.

ELECTRIC LIGHT FOR TRAINING SHIPS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Why should not the training ships and other craft moored permanently in rivers take advantage of the tides, in connection with the Faure battery, to use the electric light?

A turbine on either side, or pair of paddles, would drive the necessary dynamo machine, and the cost, considering the economy of motive power, could not fail, even after allowing interest on the expenditure for installation, to be less than that of oil.

It would certainly save trouble, as compared with oil lamps, and the risk of fire would be minimised.—Yours, &c.,

London, 10th October, 1881. G. R. N.

THE TELEPHONE IN DUBLIN.—The members of the Social Science Association were invited during their recent stay in Dublin to a *conversazione* by the Royal Society of Dublin, and amongst other things provided for their amusement was the hearing, per telephone, a performance of "The Cup," by Mr. Irving and Miss Terry, at the Gaiety Theatre, with which the Royal Society's house was in communication. The United Telephone Company lent the telephones, and Messrs. Prescott the remainder of the necessary fittings, &c. We take the following account of the affair from the *Freeman's Journal*, which says:—"The ear perceived a miniature sound-picture of the voice of Irving, in which every inflection was as distinctly marked as the lights and shades in a photograph. It was not, however, possible to follow the words distinctly. Every now and then a word could be recognised, and no doubt a person who was familiar with the play, or with any other play transmitted in like manner, would be able to follow the words very much better than those not possessed of that advantage. The widely different tones of Miss Terry were also reproduced with singular distinctness. The sounds of the music were much more audible. Still, all was miniature. It was very much as if the speaking and the music were heard through a thick wooden partition. It must be borne in mind, however, that the arrangements requisite for the display subjected the telephone to a very severe test. The lapping of the wires by such a number of ear-pieces in the listening chamber reduced the sound of each, and a further diminution of effect was caused by the subdued noise of the crowd in the house."

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DOUBTFUL SCIENCE.

The great interest and popularity of the Paris Electrica Exhibition has given rise to what may always under such circumstances be expected—a number of articles on electrical subjects in the non-technical papers and magazines. It is the province of the technical papers to give a word of caution to readers of this butterfly literature. So long as such articles are restricted to mere descriptions of what the writer has seen we have nothing to say against them, but the moment the writers attempt criticism or fall back upon hearsay they commence to show their ignorance and utter incapacity for the work in hand. A year or two back the contents of the daily papers relating to the electric light caused a scare amongst gas shareholders, because the latter were accustomed to believe that the contributors to such papers knew something at least about the question on which they had to write. The scare was a mistake, the electrical statements in the political papers utterly wrong, and the men who wrote these statements totally incompetent to understand the true features of the case. Luckily the lesson then received has to a great extent rendered the general public rather incredulous as to the value of the technical "facts" given by the daily papers. Otherwise some of the recent sub-leaders in the *Telegraph* would call for all their faith in science, but are now simply put down as the evolutions from the inner conscience of an inveterate "joker." A week or so ago our attention was directed to one of these short articles, in which the writer discussed, with every indication, so far as circumstantiality of statement went of having seen it, a wonderful electrical apparatus at Paris. This apparatus, it was stated, was intended, together with the microphone-telephone, to enable the fortunate possessor to see the actors on the stage, as well as to hear the notes of the song, or the words of the speech, not in the theatre, but in his own room. It is hardly necessary to say that this wonderful apparatus does not exist, and therefore is not to be found either in Paris or any other city under the sun. Another of these articles was noticed in our issue of Oct. 8, p. 323. The evidence here again seems to be all that can be desired, but there is no hesitation in saying that we do not believe one word of the article. The reference to the "electrical apparatus for the detection of metal substances" is evidently a reference to Hughes's induction balance. According to the discussion at the late meeting of the British Association, the indication of the induction balance would hardly be sensitive enough to show a mass of metal at the deepest part of Lake Erie. But, of course, the writer of these short articles is not deterred by the want of sensibility of all known instruments. The fact is as he states it, or rather he would have the public believe such to be the case, however difficult a task that may be. Our only explanation of such articles appearing in a paper that professes to have a certain amount of intelligence amongst the members of its staff is that the article was really a clipping from some comic paper, and accidentally obtained the position of prominence in which it appeared. It is difficult to understand why, on any other supposition, the question as to the probability of such apparatus existing was not put to some person acquainted with electrical science.

The examples we have referred to are but some of a long series of similar articles from various sources. We have a great dislike to discussing such articles, but circumstances render such a course at times necessary. Thousands of students are turning their attention to electrical subjects, and it is harder for them to unlearn what is wrong than to learn what is right. It is for their sake that we say, beware of these articles, teeming as they do with incorrect notions of the science, which have to be eradicated. It would be unjust to say that all political papers are careless of their scientific information. Some we know have endeavoured to provide better material, and sooner or later the rest must follow their lead. The daily papers, however, are not the only defaulters, and perhaps their articles are even less important than those of the more pretentious monthlies. Many of us in England have been struggling to impress upon the student mind the necessity of studying the "circuit," conductive, inductive, and magnetic, but a writer in *Harper's Magazine* says there is no circuit. In such a case the student is, brought face to face with a great difficulty. His master says there is a "circuit;" he reads in *Harper's* there is no such thing.

We say that the writer in *Harper's* is wrong, and his thesis will not bear discussion. We say again that his use of the word "indefinite" is incorrect in the sentence "The telegraph consists essentially of a battery, a key, or circuit-breaker, a sounder, and a line wire of indefinite length." The amateur and the young student will think "indefinite" includes "unlimited," and that a line wire may be of unlimited length, and this will at some future time have to be "unlearned." It is almost unnecessary to say that although we take exception to certain statements in this article, we do not condemn it as a whole. Parts of it are certainly excellent, and the description of certain apparatus clear and good. These brief remarks will sufficiently illustrate our object, which is to hint that the men who would popularise science should have no mean acquaintance with the subject on which they write. There is a far greater responsibility resting upon their shoulders than at first sight seems to be the case. Their work appeals to the learner, and should contain nothing that the existing state of the science shows to be inaccurate, or the work does harm instead of good. Unfortunately, most of

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the men who write these popular articles are men possessed of little or no real scientific knowledge, who gather information for the purpose of making money and not for the propagation of the truth. The difference between the writer and the reader is simply that the former is a constant visitor to a good library, and consults encyclopædias and technical papers, stringing together the information he collects into a readable article, which the latter reads. To both Ohm's law is equally in an "unknown tongue;" resistance, electromotive force, and other technical terms are words and nothing but words. We should suggest to those desirous of gaining a little knowledge of these subjects that they first of all master the elementary principles as given in such works as those of Fleeming Jenkin, and if possible to attend the classes of lecturers of proved ability. Do not learn in order to unlearn, and what is learnt let it be learnt thoroughly.

THE ELECTRICAL EXHIBITION AT PARIS.

Electric Lighting Apparatus.

In a recent issue we mentioned that our contemporary *La Lumière Electrique* had devoted the whole of its pages in the issue of October 1st to the description and illustration of the incandescent forms of the electric light. We are indebted to our contemporary for the use of the illustrations which appeared in its issue of that date. Those illustrations marked thus * are from our contemporary. The description of the apparatus which we give, does not, however, profess to be a translation of the admirable article of Count Th. du Moncel. We, like thousands of others, visited the exhibits of Mr. Edison over and over again, and formed our own opinions thereon. We had many opportunities of conversing with Mr. C. Batchelor and Dr. Moses on the subject of the exhibits, and made a few tests of the incandescent lamps, in order to obtain a personal and not merely a hearsay knowledge of their capabilities. It is due to Mr. Edison's representatives to say that full and free permission was given for investigating, and for testing the exhibits in any manner we pleased, that our questions were always frankly answered, and that every facility was given for obtaining a thorough knowledge of the capabilities of the incandescent lamps. It is quite evident that Mr. Batchelor and Dr. Moses thoroughly believe in the light. Whether their belief has a just foundation is a question that can only be answered at some future date. We simply mean by this, that time and use alone will answer the important question—Does this light give what is required for general purposes? It is no question of laboratory experiments, it is no question of success under the inventor's own or his representative's supervision, but, Is it suitable to be sown broadcast throughout the civilised world and to become one of the tools for men to use?

There are four systems of incandescent electric lighting before the world—that is, in a position to be adopted by any one who chooses to have such a light. These are (1) the Swan, (2) the Edison, (3) the Lane-Fox, and (4) the Maxim. We have said four systems; we should rather have said four modifications of one system. Each modification has its own supporters, who maintain that the particular modification is superior to the others, and are ready to discuss the advantages claimed. Without attempting to enter into details at present as to similarities and differences between these lamps we may be permitted to make a definite statement of our conclusions.

We believe the incandescent electric light to have attained the point when it can successfully compete with gas, if it can be conclusively proved that either one of the above type of lamps has an average life of a thousand hours when used in consecutive periods of four hours, and can be sold to any purchaser for a florin.

The representatives of Mr. Edison state that the most recent figures give as the average life of his lamp something over a thousand hours, and that his system of manufacture has been so carefully considered that the lamps can be produced for a very small sum, less even than a florin.

The evidence we require, however, is of a different kind—it is purely commercial. We ask where is the shop in London, Birmingham, Liverpool, Edinburgh, &c., at which we can purchase the lamp, and what the price to any casual purchaser? When such shops exist we shall have the evidence required by practical men. Till then, as rational beings, we accept the statement that the economy of manufacture is very great, and we confess that reasoning by analogy tends to bear out such statement.

To return to our more immediate object, which is a description of the incandescent light, especially as exemplified at Paris. The first electric lamp operating by incandescence of which we have any actual record seems to be that invented by M. Starr, and patented in England by his agent, Mr. King, in 1845 (Fig. 1). It consists of a conducting wire, W, sealed in the glass of the globe G, and connected with the carbon rod C, the lower end of which is in contact with a second conductor, W', resting in mercury. Q is a porcelain supporting piece.

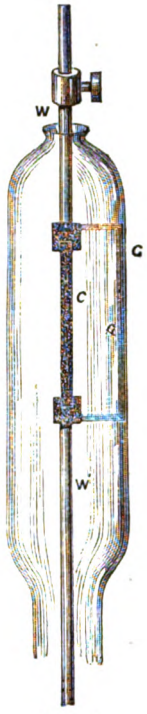

Fig. 1.

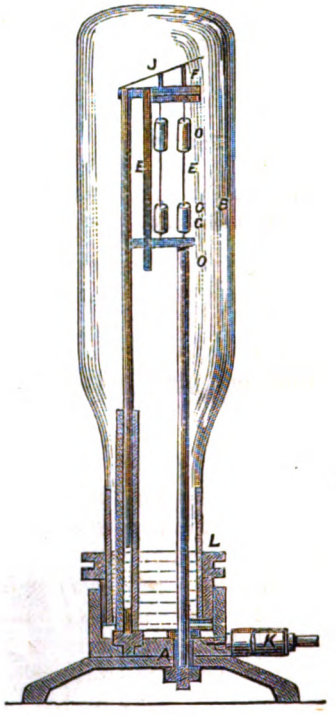

Fig. 2.

This lamp was modified by Lodyguine, a Russian physicist, who in 1873 invented a lamp in which a rod of carbon was made to diminish considerably in section in the part to be rendered incandescent, and a second rod provided through which the current was switched when the first carbon was destroyed. Then followed the Koun lamp (Fig. 2). This consists of a glass vessel provided with a metal cap and packing box below, by means of which it can be closed air tight. A tube at K allows of the exhaustion of air from the interior, and the filling of the interior with any inactive gas. Two upright metallic conductors, which are connected respectively with the two poles of the battery, pass up through the glass globe B, and at their upper ends support, as shown, two or more rods of carbon, or other conductors. The electric connection with these rods is made as shown by means of the lever J, which communicates first with the longest copper rod F, and when the carbon E connected to that is used up falls on the next longest, and so on. The base A is of copper, the globe being clamped to it by means of the collar L pressing on soft rubber washers. When the whole of the carbons E are consumed the lever J makes contact with the copper rod E, and so the circuit is not interrupted.

M. Bouliguine invented a lamp in which the carbon feed

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is somewhat like that of Werdermann, M. Fontaine one in which the carbon pencils are held in rigid contact, and M. Sawyer one in which the incandescent rod is held between

Fig. 3.*

Fig. 4.*

two large blocks of carbon. These and other incandescent lamps did not stand the test of trial, and thus, as M. du Moncel says, the world was incredulous when, in 1879, Mr. Edison announced an incandescent lamp. Experiment had succeeded experiment; carbon, platinum, iridium, &c., had been tried, and every trial had ended in failure. The results seemed conclusive, and the scientific world doubted, till Mr. Swan's lectures and experiments showed that the results of preceding experiments had not been favourable to incandescent lighting, because the experiments carried out were not carried out with the proper materials under the best

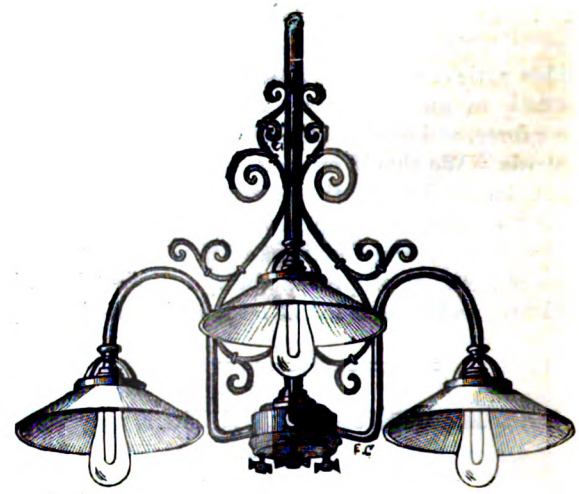


Fig. 7.*

conditions. Almost simultaneously Messrs. Swan and Edison, the one in England, the other in America, made public a lamp far superior to anything that had gone before. Mr. Swan, we believe, must have the credit of having consistently, through evil and through good report, for many years laboured to perfect such a lamp; and as M. du Moncel says, Mr. Edison continued his experiments, notwithstanding the lively opposition to that class of lamp, notwithstanding the sharp criticisms, and did not cease his work

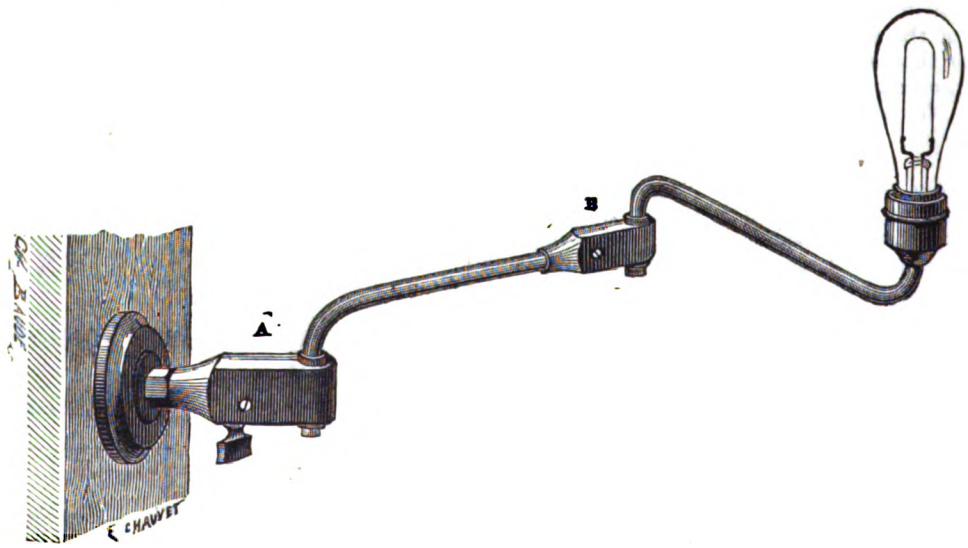
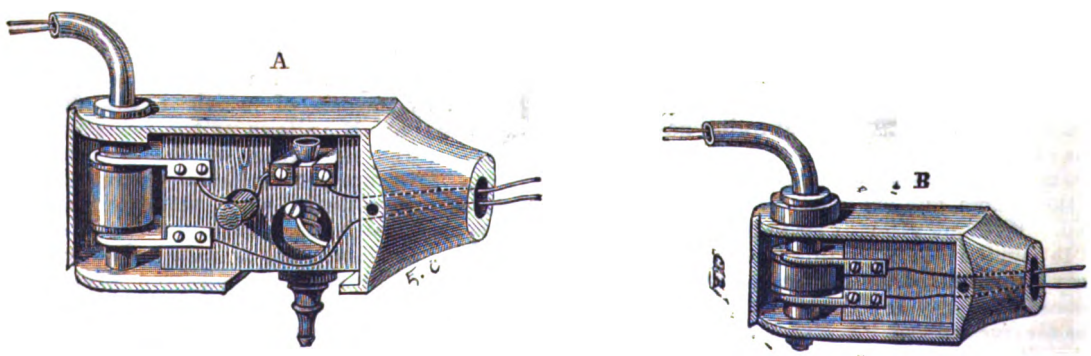


Fig. 5.*



Figs. 6* and 6A.*

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till he had brought it into a practical form, such as is to-day admired by all who visit the Exhibition. Lamps to the number of 160 light the two rooms devoted to Edison's exhibits. The lamps shown (Figs. 3 and 4) are of two sizes, one intended to give from eight to ten candle light, the other from sixteen to twenty candles, the part to be rendered incandescent being a very thin strip of carbon of horse shoe shape, fastened by platinum clips to the conducting wires, and enclosed in a globe highly exhausted; in fact, in as perfect a vacuum as can be ordinarily obtained. It is easy to raise the lamps to a higher degree of incandescence, but the life of the lamps is not so certain. The problem of the incandescent light is not easily solved. We must, as we have said before, have a lasting lamp; it must give a good steady light, and, if it has to compete with gas, must be economical. Now, the greater the incandescence the greater the economy as regards light, but the shorter the life, and hence the cost of replacing. There is probably for all these lamps a certain light best suited for long life, and this has to be determined by experiment. Mr. Edison's experiments tend to show that his lamps should have a current to give about eight candles and sixteen candles respectively, according to the lamp. The whole process of manufacture of these lamps is illustrated. Mr. Edison has decided to use carbon obtained from bamboo. The bamboo is first cut into proper lengths, then divided into two, these two pieces each divided into three more, and so on, till the proper size is reached for the process of carbonisation. Specimens of the material in every stage are shown, also of the glass which ultimately forms the globe of the lamp. The lamp shown above is intended to fix into a stand for table use, and the contact is made by the screw, the lamp when in position appearing as in Fig. 4. The carbon to be rendered incandescent is connected by platinum clips to the line wires. A very neat arrangement is shown whereby the lamp can be placed on an arm fixed to the wall in Fig. 5. The arm has two joints, A and B, the communications being effected by two insulated contact pieces upon which press the two springs as shown in Figs. 6 and 6A.

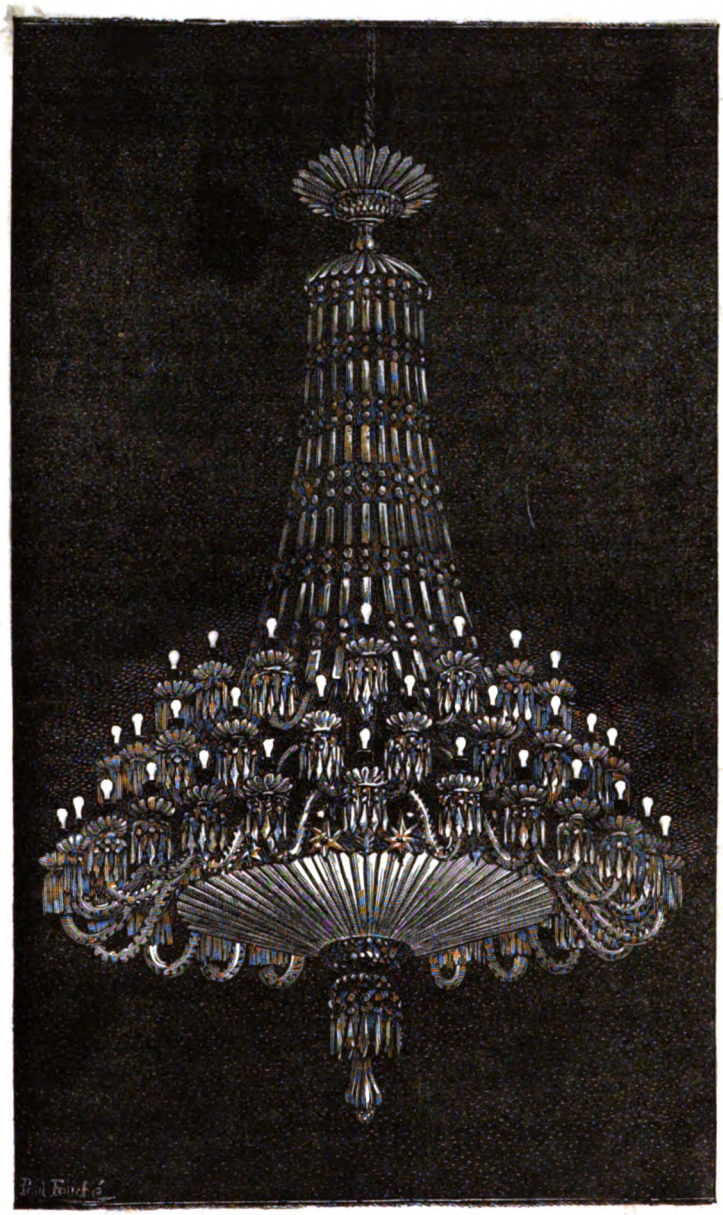

FIG. 8.*

We shall speak of the main and local conductors later on. In the arm at A, as also in the cluster of three as shown in Fig. 7, the current can be turned on and off by means of plugs or cocks. It is necessary when the question of a number of lamps in circuit is considered to arrange for the turning on or off of any number of them without interfering with the rest. In the case of arc lamps generally the action of cutting out a lamp puts into the circuit an equivalent resistance, so that the total resistance of the whole circuit is fairly constant

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Mr. Edison has adopted the plan, also followed, we believe, by Mr. Crompton, of acting upon his field magnets instead of interfering with his circuit. How this is accomplished will be seen in dealing with the machine, &c.

The lighting of the two rooms at the Exhibition is effected not only by means of lamps on brackets as described, but also by means of two clusters—one to each room—of eighty lamps each. Fig. 8 shows one of these lustres which all agree has a very pretty effect. The light is steady, not intensely white, the temperature of the room is not unduly raised, nor is the air contaminated by noxious gasses given off by the lights, as is the case when gas is used. The lighting of ordinary rooms would probably be carried out somewhat as shown in the accompanying Fig. 9, by means of small or large lustres, according to the size of the room, and bracket lamps.

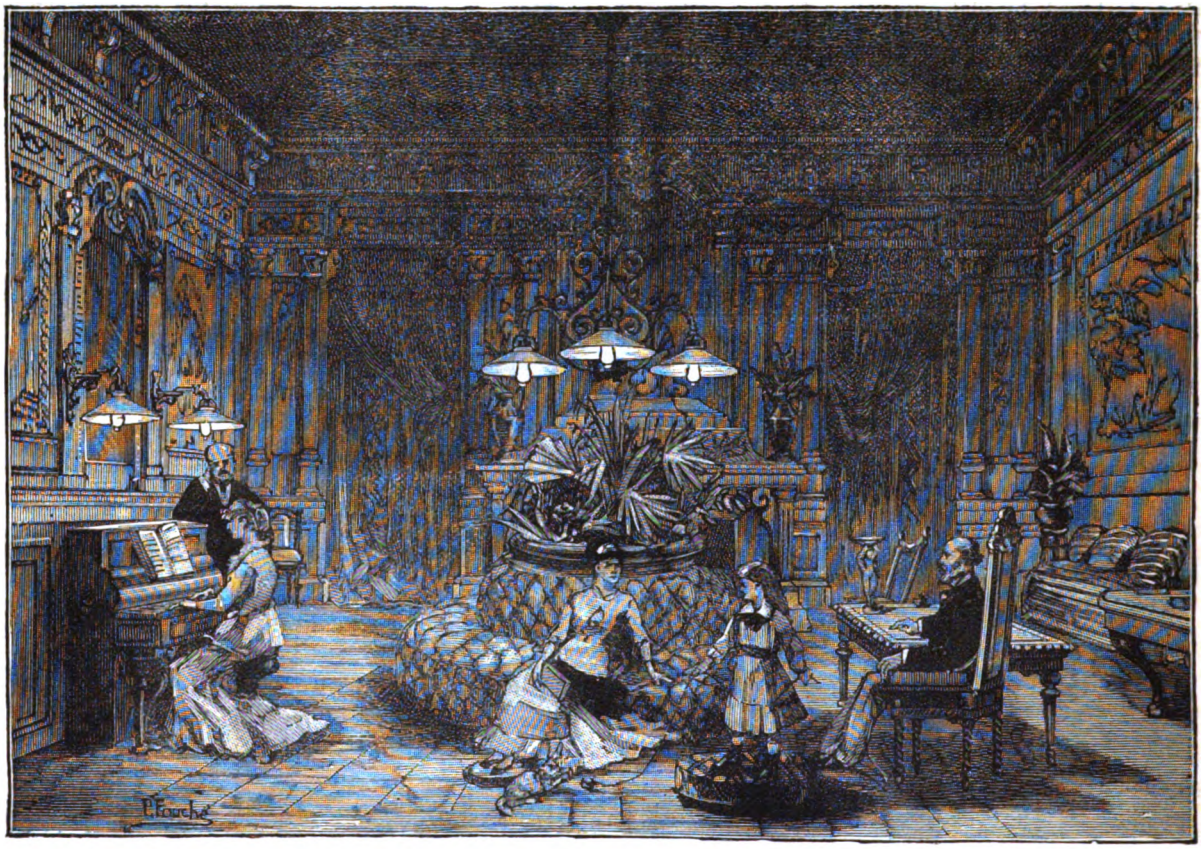

FIG. 9.*

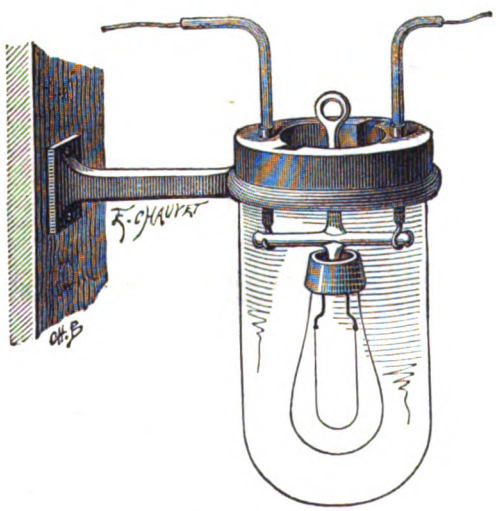

FIG. 10.*

In a previous article we referred to a lamp which Mr. Edison has designed for use in mines. In this system, represented in Fig. 10, the lamp is inserted into a glass vessel holding water, and suspended by suitable means. The necessary contacts are all under water, and hence it is argued there can be no danger from explosion.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY (LIMITED).

Report of the directors for the half year ended the 30th June, 1881, to be presented to the sixteenth half-yearly general meeting, to be held at the Cannon-street Hotel on Friday, the 28th October, 1881, at twelve o'clock. The directors submit the annexed accounts and balance-sheet for the half-year ended 30th June, 1881. The revenue for this period amounted to £86,017 3s. 3d., the working expenses to £12,710 0s. 9d., leaving a balance of £73,307 2s. 6d.; to this is added £34,310 15s. 9d., the undivided profits to 31st December last, making a total of £107,617 18s. 3d. After deducting income-tax, £1,107 0s. 9d., there remains a balance of £106,510 17s. 6d. A third interim dividend amounting to £19,500 has been distributed since the last accounts were presented, leaving the sum of £87,010 17s. 6d. for appropriation. The directors now recommend the declaration of a final dividend of 3s. per share, making a total dividend of 6 per cent. for the year ending 30th June, 1881, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £32,500, being a distribution in the aggregate of 7 per cent. for the past year, leaving a balance of £54,510 17s. 6d., of which amount £50,000 has been placed to the reserve fund, increasing that fund to £345,349 10s. 7d., and £4,510 17s. 6d. carried forward. The Company's cables continue in good working order. The directors regret to announce the recent lamented death of their colleague, Mr. William Henry Clark. By Article 76 of the Articles of Association, Sir Thomas Fairbairn, Bart., and Mr. Henry Daniel Gooch will retire by rotation, but being eligible for re-election, they offer themselves accordingly. The two auditors, Mr. Henry Dever and Mr. John Gane, also offer themselves for re-election.

WATER POWER IN INDIA.—The *Pioneer* recently suggested the utilising of the vast amount of water power which now runs to waste on the Indian canals. How could it be better applied than by distributing electricity, to be turned into power at will, or to light cities?

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CANTOR LECTURES.*

(CONTINUED FROM PAGE 350.)

THE BÜRGIN MACHINE.

Another continuous-current machine is the Bürgin machine from Switzerland, which has only just been introduced into England by Mr. Crompton.

Four or six coils are wound on the sides of a square or hexagonal frame, consisting of iron wires. The corners of the frame come very near to the poles of the magnets. There are six or eight of these frames arranged successively in the form of a helix. The action is similar to that of the Gramme machine, the dynamo-electric principle being introduced in this as in other machines. The construction of the machine is very simple, and its efficiency has been proved by M. du Moncel and also by Mr. Crompton to be remarkably good. These machines are of small internal resistance, and are driven at high speeds (up to 1,600 revolutions a minute), so that there is considerable electromotive force.

The efficiency of certain Gramme machines exhibited by Mr. Crompton, and tested at the Glasgow Electric Light Exhibition, was shown to be such that, with a power of 4 h.-p. expended in producing the current, only ½ h.-p. was expended on friction and passive resistances, so that about 88 per cent. was net power. This 3½ h.-p. converted into electricity gave a current of 32 webers through a resistance of about 2 ohms, *i.e.*, an internal resistance of 1·077 ohms, and the arc of a Crompton lamp giving a light equivalent to 2,158 candles.

Now, we may compare with these the results obtained by Mr. Crompton for the Bürgin machine, running at a speed of 1,675 revolutions per minute.

Five machines were tested, and the total work expended was 5·45 h.-p. The amount spent on friction and passive resistances when the circuit was open was about ·25 h.-p., so that about 86 per cent. is net power. The work, converted into electrical energy 5·2 h.-p., gave a current of [illegible]15 webers, through an internal resistance and conducting wires of 2·8 ohms, together with the arcs of 3 Crompton lamps (about 5 ohms), each giving a light of 2,103 candles, measured horizontally; the electromotive force $= \frac{\text{work}}{\text{current}}$ being equivalent to 163 volts.

With photometric measurements made horizontally, the electric light being level with the gaslight, the carbons being concentrically adjusted, and the length of the arc being about 3mm., the greatest amount of light was found to be obtained at 1,675 revolutions per minute, with 3 lamps each of 2,103 candles, or with 4 lamps each of 1,246 candles. The upper carbon was 10mm. and the negative carbon 13mm. in thickness. The consumption of the upper carbon was 4cm. and the lower nearly 2cm. per hour. The total horse-power expended was 5·55 h.p., and the current with 3 lamps varied from 18·36 to 21·94 webers, and with 4 lamps from 16·9 to 19·6 webers. All three lights were very steady, and much whiter than the single lights of Gramme's machine.

Mr. Crompton has been kind enough to lend me a new Bürgin machine, about which he gives me the following facts:—It was tried at 1,620 revolutions a minute, and a current of 28 webers was sent by it through three lamps, in series. When the arcs were lengthened to one-fourth of an inch each, the current was twenty-four webers, and the arcs gave a light of 5,000 candles each, the photometric measurements being made in the most advantageous direction.

The British Electric Light Company have been good enough to place at my disposal for this evening, and for my next lecture, two Gramme machines for trying some of the electric lamps which have been kindly lent to me.

These machines are driven by a steam engine lent by Messrs. Robey, of Lincoln, and for the Brockie and other electric lamps I am indebted again to the British Electric Light Company; to Dr. Siemens; to Mr. Crompton, to Mr. Latimer Clark, for the Lontin lamp; for the Rapieff and Wilde electric candle, to Mr. Berly; to the Jablochkoff Electric Light Company for their candles; and to the Anglo-American Electric Light Company for the Brush lamp.

THE BROCKIE LAMP.

The upper carbon is attached to an iron tube, which passes into a solenoid, through which it passes as the positive carbon burns away. The solenoid forms a shunt or by-pass for the arc, and takes a small part of the current, and holds up the iron tube which carries the upper carbon; as more current passes through the coils, the motion of the carbon is stopped.

A commutator is so arranged and driven by the dynamo-machine as to break the current, and allow the carbons to come in contact for an instant at regular intervals, say every minute. Then the circuit is completed again, the upper carbon is drawn to its proper distance apart, and the light continues. At every minute the light goes out, but instantly relights, and no variation of light is perceived.

SIEMENS'S DIFFERENTIAL LAMP.

A thick wire bobbin, T, carries the arc current, and another fine wire bobbin, R, forms a shunt to the arc. The interval between the bobbins equals the height of each of them. The iron rod, SS, is of twice the length of each bobbin, and its ends in the normal position are at the centres of the bobbins. The

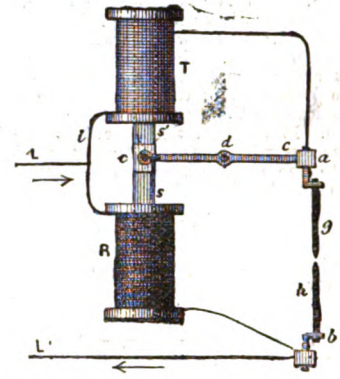

FIG. 5.—SIEMENS'S DIFFERENTIAL LAMP.

attraction by the thick wire bobbin tends to lengthen the arc and diminish the current, and so its attraction is weakened, and the arc is again diminished, the attraction on the iron being regulated by the change of resistance in the arc. A pendulum arrangement is attached, to prevent the oscillations of the carbon from being too sudden.

(TO BE CONTINUED.)

THE EASTERN EXTENSION AUSTRALASIA AND CHINA TELEGRAPH COMPANY (LIMITED).

The sixteenth ordinary general meeting of this Company was held on Wednesday, the 19th instant, at the City Terminus Hotel, Cannon-street, under the presidency of John Pender, Esq., M.P.

The SECRETARY (Mr. F. E. Hesse) read the notice convening the meeting, and subsequently the minutes of the last general meeting, which were confirmed and signed by the chairman. The report of the directors (which had been published in *The Electrician*) was taken as read.

The CHAIRMAN said: Gentlemen, before asking you to approve the report, I shall go over, as usual, some of the figures in the report, so that you may have some explanation of them. The gross receipts for the half year ended the 30th of June, 1881, amounted to £191,580, as against £173,020 in the corresponding period of 1880, showing an increase of £18,560. Of this £9,828 was due to increased traffic, the balance of £8,732 representing additional subsidies received during the half year as follows:—From Australian Governments in respect of duplicate cable, £5,400; and from the Government of the Phillipine Islands for Manila, £3,332. The expenses for the past half year, including income-tax, were £55,230, as against £50,384 in the corresponding period of 1880, showing an increase of £4,846, which was more than accounted for by the following items:—Increased expenses for repairs and renewals of cables and maintenance of ships (which must always be a fluctuating item), £4,140. I shall, however, refer at greater length to these expenses further on. The additional income tax was £523, and the contribution to the staff endowment insurance fund was £359. The net income for the half year was therefore £94,755, against £95,535 in the corresponding period of 1880, or a decrease of £780. Out of the half year's revenue, however, a sum of £13,295 has been set aside for the redemption of the Australian Government subsidy and Manila debentures as they become due, and a sum of £2,500 has been absorbed for interest on Manila debentures, which did not appear in the accounts for the corresponding period. But for these special charges there would have been an increase of about £14,000 in the net revenue. During the half year an interim dividend of 1¼ per cent. has been distributed, and another of similar amount has been paid to-day, together with a bonus of 1s. per share, which I hope you have all received, making a total payment of 3 per cent. for the half year. The balance carried forward is £34,830. There is one paragraph in the report to which I particularly wish to refer, namely, paragraph 6, from which you will observe that we have decided to lay a new cable, of 580 miles in length, between Singapore and Batavia (Java). We have come to this decision because during the last three years alone the repairs on this section have been so numerous and costly, owing to the serious attacks of the little marine insect, called the "Teredo," that the Company have spent from £7,000 to £10,000 a year to maintain the line in working order. I may mention that in 1873 we took out six faults; in 1874, 19 faults; in 1875, 22 faults; in 1876, 1 ; in 1877, 10; in 1878, 31; in 1879, 21; in 1880, 39 faults; making

* Reprinted from the *ournal* of the Society of Arts for August, 1881.

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the large total of 166 faults removed from this cable. I have here on the table a small piece of cable, picked up between Singapore and Batavia, showing the effects of the teredo attacks. The gutta percha is scooped out in the most extraordinary way down to the copper. The moment the insect reaches the conductor it dies, but the signals are so affected that the cable is useless until it is repaired. If any one would like to look at this cable, it is at his service, and will be found very interesting. We have made experiments to resist the action of this little insect, and so far have been successful, our electrician reporting in a letter recently received, that "so far the brass-taped cable has proved a success. There have been no signs of insects in that laid in October, 1878, in the old Australian cable, close to Port Darwin, one of the most troublesome spots." The piece of cable I have in my hand is a specimen of the new form of cable. The copper conductor is first covered with gutta percha, which forms the core; this is then covered with a tape, over which is placed the brass ribbon; over this comes another tape, which is covered with hemp, around which the iron wires are placed; the iron wires are then protected by a further covering of hemp and compound. The new cable will cost £95,000, but we do not intend to charge this to capital. The Telegraph Construction Company have entered into this arrangement in such a liberal spirit, that I believe we shall only pay the bare cost of the manufacture of the cable. Our arrangement also provides for the payment of the money when it is convenient for us to do so. It will not, therefore, interfere in any way with the dividends, as the money will be taken from the balances that would otherwise be carried to the reserve fund. The ss. "Seine" left England with the new cable on the 1st instant, and will, it is anticipated, lay the same before the end of next month. When I have the honour to address you six months hence, if I have that pleasure, I hope to be able to report that the insect faults between Singapore and Java have terminated. The existing cable will be picked up, and as much of it as is in good condition will be recovered by our people at Singapore, so that we hope in this way to get a considerable quantity of good cable from the old line. Our business has progressed very satisfactorily, and if we could reduce the charges for repairs, which average over £40,000 a year, and become better masters of the cable in that respect I am quite sure that the result would be increasing dividends. However, we are doing all that we can to obviate these troubles and difficulties, and so far as the teredo is concerned, I think we are likely to master them. Now before I ask you to approve the report I must allude to the loss the Company has sustained since I last addressed you. Colonel Glover, one of our directors and valuable officers, who was associated with this Company from the beginning, died suddenly on the Continent. He always identified himself very warmly and very earnestly in the work of this Company. He visited all our stations in the East and in Australia, and took an active part in bringing to a successful conclusion the negotiations with the Australian Governments in regard to the duplicate cable which they subsidised. We all regret Colonel Glover's death, and we feel it is only right that we should pay this tribute to his memory in the presence of the shareholders who with the Board have benefited so much from his services. I may mention incidentally that we have a large number of directors on the Board. This, however, was necessitated more or less by the amalgamation arrangements which were made on the formation of the Company. We intend for a short time to work without adding to the Board. We think that, situated as this Company is with the Eastern Company, we may avail ourselves as far as we prudently can of the services we can obtain in that quarter. This Company will, therefore, have the benefit, for a time at least, of a portion, if not all, the salary Colonel Glover received. I now beg to move the resolution, which is as follows:—"That the report and accounts of the directors now submitted be received and adopted."

The Most Hon. the Marquis of TWEEDDALE: I beg to second the motion.

The CHAIRMAN: Before I put the motion, if any shareholder has any question to ask I shall be very glad to answer him.

After a pause, he continued: Well, then, as there is no reply, those in favour of the motion will please to hold up their hands. On the contrary. Carried unanimously.

Mr. JOHN NEWTON: I think that the shareholders of this Company would like to have the opportunity of placing in a more prominent form their appreciation of the services of the late Colonel Glover. It is only proper in such a case as this, where important services have been rendered to the Company, that we should place on record some tribute in recognition of those services. I, therefore, think that the shareholders would not do their duty if this meeting did not pass a vote of condolence with Colonel Glover's widow and family. The shareholders of the Company have derived considerable advantages from the services of Colonel Glover. His successful working in obtaining subsidies for us has tended to strengthen and consolidate the Company for a considerable number of years. We have, practically, a monopoly of Australian business, and, consequently, we have a powerful protection against competition, and it is to the services of Colonel Glover that we are indebted for these advantages. I think, sir, that this meeting would be glad to be allowed to share in the regrets which you have expressed, and to pass a vote of condolence and sympathy with the widow and family of Colonel Glover. I beg, therefore, to move "That this meeting desires to express its deep sympathy and condolence with the widow and family of Colonel Glover in the bereavement they have sustained by his sad death."

Mr. STARNES: I have much pleasure in seconding the motion.

The CHAIRMAN: I am very much pleased that this has come from the body of the meeting. The directors did their duty by passing a resolution at the Board, which was conveyed to Mrs. Glover, and I only read this morning at the Board a very nice answer from that lady, showing her appreciation of the sympathy expressed by Colonel Glover's old colleagues. That such a resolution as this, coming spontaneously from the body of the meeting, will be equally acceptable and grateful to her I have no doubt; and I am very much pleased that it has come as it has—perfectly unsolicited and unarranged. I think the feelings expressed in that way are warmer, and are more appreciated by those for whom they are intended. I shall be very glad if Mr. Newton will hand in his resolution, and I will take care that it is conveyed in a proper manner to Colonel Glover's widow and family. I now put the motion, and those in favour of it will kindly hold up their hands [several voices, "All, all."] It is carried unanimously. That finishes the meeting.

The proceedings then terminated in the usual manner.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Oct. 19.		Business Done Week Ending Oct. 19. Highest.	Lowest.
Anglo-American	52¼,	53	53	52
Do. Preferred	81,	82	81¼	81
Do. Deferred	23¾,	4	24	23½
Brazil Submarine	11½,	⅛	11½	10⅝
Cuba	9½,	10	—	—
Do. Preference	16,	17	—	—
Direct Spanish	5,	⅛	—	—
Do. Preference	14,	18	—	—
Direct United States Cable	10½,	⅛	10⅝	10½
Eastern Telegraph	10⅝,	⅛	10⅝	10⅝
Do. 6 per Cent. Preference	13,	⅛	13⅛	13
Do. 5 per Cent. Debentures, 1899	105,	108	—	—
Eastern Extension	11,	⅛	11⅛	11
German Union	10,	⅛	—	—
Globe Telegraph and Trust Company	6⅛,	⅛	6⅛	6⅛
Do. Preference	12⅛,	⅛	12⅛	12⅛
Great Northern	12,	⅛	12⅛	12⅛
Indo-European	28,	29	—	—
Mediterranean Extension	2¼,	3	—	—
Do. Preference	9⅛,	⅛	—	—
Reuter's	11,	12	—	—
Submarine	280,	290	—	—
West India and Panama	1⅛,	2¼	2	2
Do. 1st Preference	7⅛,	⅛	7⅛	7⅛
Western Brazilian	7⅛,	⅛	7⅛	7⅛
West. Union 7 per Cent. 1st Mortgage	125,	130	—	—
Do. 6 per Cent. Sterling Bonds	104,	107	105	105

BRAZILIAN SUBMARINE TELEGRAPH COMPANY (Limited).—NOTICE is hereby given that the SIXTEENTH ORDINARY GENERAL MEETING of the SHAREHOLDERS of the BRAZILIAN SUBMARINE TELEGRAPH COMPANY (Limited), will be held at the CANNON STREET HOTEL, LONDON, E.C., on FRIDAY, the 28th day of OCTOBER, 1881, at 12 o'clock noon, when the Report and Accounts of the Directors will be presented, a dividend declared, and the ordinary business of the Company transacted. And NOTICE is also given that the REGISTER of TRANSFERS will be CLOSED from the 20th to 28th October, both days inclusive.

By order, RICHARD COLLETT, Secretary.

8, Great Winchester-street, London, E.C.,
18th October, 1881.

ELECTRIC LIGHT DISTRIBUTING STATIONS.—Owing to the especial adaptability of the Brush System for Electric Lighting on a large scale, we have made ARRANGEMENTS for the ESTABLISHMENT of ELECTRIC LIGHT DISTRIBUTING STATIONS throughout England, in order to meet the requirements of those who may desire to have the Electric Light, but do not care to invest in a separate plant, either because the number of lights used might not be sufficient to justify the outlay, or because they object to having engine and machinery on the premises.

The fact that only by the "Brush" system (of which we hold the patent rights for the North of England, and act as general agents for the United Kingdom) can a large number of lamps be run from one station on one circuit of wire, enables us to supply the light on such terms as will successfully compete with gas, and at the same time yield a vastly superior light.

We shall be glad to forward forms of contract on application.

(Signed) HAMMOND and Co.

110, Cannon-street, London, E.C.

NON-MAGNETISABLE WATCHES.

R. WEBSTER, Chronometer Maker to the Royal Navy,

Supplies Watches of his own Manufacture which cannot be influenced by Dynamo and other Electric Machines, from £7. Watches can be converted to this plan.

5, QUEEN VICTORIA STREET, LONDON, E.C.

TO ELECTRICAL ENGINEERS and EXPERIMENTALISTS.—WATCHES which CANNOT be "MAGNETISED," as exhibited at the Electrical Exhibition, Paris.

E. DENT and Co. (makers of the standard clock of the Royal Observatory, Greenwich), 61, Strand, and 34, Royal Exchange, London (only addresses).

N.B.—Watches can be converted to this plan.

TO TELEGRAPH INSTRUMENT MAKERS, ELECTRICIANS, &c.—WANTED, a thoroughly competent MAN to take charge of the Instrument Making Department in a firm of Telegraph Engineers, &c. Must be well up in estimating and piecework.—Apply, in strict confidence, stating age, experience, references, and salary required, to "A. B." office of "THE ELECTRICIAN," 396, Strand, W.C.

H. W. BROOKER, ELECTRICAL ENGINEER.—Inventors' ideas worked out, dynamos made and repaired.—39, Compton-street, Goswell-road.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,

76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.

Manufacturer of Electric Signals, Telephones, and all descriptions of Telephonic Apparatus for Exchanges or Private Lines.

Messrs. Ayrton & Perry's Absolute Galvanometer for Strong Currents.

NOTICE.—THE GOWER-BELL LOUD-SPEAKING TELEPHONE.—*A limited number of these valuable Instruments, with royalties fully paid, may still be obtained of* EDWARD PATERSON, *who is prepared to tender for the erection of Telephone Exchanges or Private Lines in any part of the United Kingdom. As the policy of the Proprietors of the Patent is now only to rent these Instruments, parties desirous of purchasing should lose no time in securing them.*

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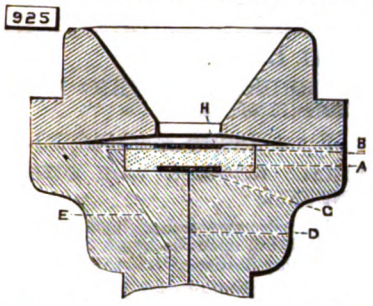
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

925. IMPROVEMENTS IN TELEPHONE TRANSMITTERS, *C. Moseley.—4th March*, 1881. 6*d*.

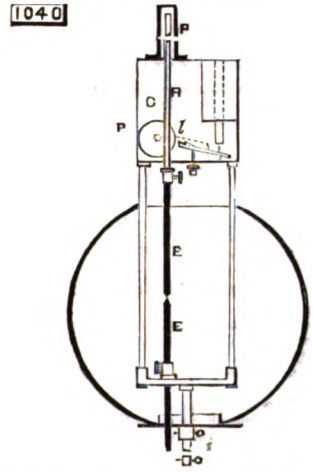
The inventor makes use of the sulphide of copper known as Cu S, either powdered or in a compressed state, to intensify the sounds by lessening the resistance in the transmitter. The drawing shows the method of using it in the powdered state. B and C are electrical conductors, which may be made of the compressed proto-



sulphide of copper, or of carbon, and which are connected to the battery wires D E; the diaphragm is marked H. The cavity A is filled with the powder, which, being in contact with B and C, forms part of the circuit. In all cases the inventor prefers to make the contacts with the proto-sulphide of copper by means of a conducting material, such as platinum, between which and the copper no chemical reaction can occur. Other methods of using the compressed copper are described in the specification.

1,040. ELECTRIC LAMPS, *A. A. Common and H. F. Joel.—10th March*, 1881. 6*d*.

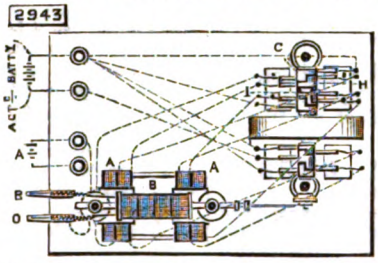
The invention relates to improvements in arc



light regulators, and also in the Joel incandescent lamp patented in 1879, No. 5,157. Several variations in the method of regulation are shown, of which we describe the following:—Referring to the figure, when an electric current is sent through the thick wire coil it passes through the carbons E, and back to its source; the core C is drawn into the coil and raises the lower end of a lever, causing the other end to move on the pivot, grip a disc, and turn the pinion P, this raises the rack R with carbon E attached, and so strikes the arc. When the latter becomes too long the action of the coil is weakened, and the shunt coil strengthened; the core drops again, releasing the lever from the disc and allowing R to fall. As R falls glycerine from the cylinder P^1 falls with it, and retards and regulates its fall as described in A. A. Common's patent, No. 368, 1870. The improvements in the incandescent lamp described in the specfication refer chiefly to causing good contact between the carbon pencil and the other electrode.

2943. IMPROVEMENTS IN ELECTRO-MAGNETIC MOTORS, *S. Pitt.—5th July*, 1881.—(*A communication from M. G. Farmer.*) 6*d*.

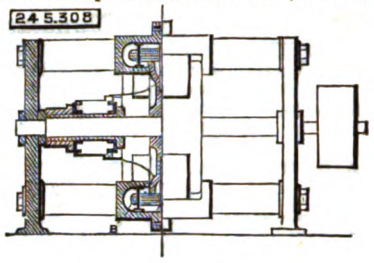
This invention relates to improvements in electro-magnetic motors, in which the ends of an electro-magnetic coil are united just before the connection between the helix and the electrical generator is broken, whereby the spark due to the discharge of the induced current from the coil is prevented. In the figure the helices A are arranged so as to act on the armature B, which forms the core of the four helices, and this latter is free to move to and fro under the attraction of one or other of the helices. These helices are connected with the generator by means of the automatic commutators G, H, I, &c., as shown in the figure, so that during the movement of the armature in either direction, the two helices which



are thus simultaneously in action are included in the same circuit, and exert their attractive forces in the same direction upon the armature; while at the completion of the stroke the terminals of the pair of helices are first united, so as to form a closed circuit before the battery current is cut off from them, and the commutators are so arranged with reference to the terminals of the helices, that when thus united the connections are such that the induced current generated within them by the magnetic discharge of the core or armature tends to traverse the respective helices in opposite directions. Thus the induction currents in each helix of the pair neutralises the other, and the effect on the armature is inappreciable. A constant current traverses the armature B from the battery O, which thus becomes a permanent magnet.

245,308. MAGNETO-ELECTRIC MACHINE, *Richard R. Moffatt and Sylvester Chichester, Brooklyn, N.Y.—Filed January 10th*, 1881.

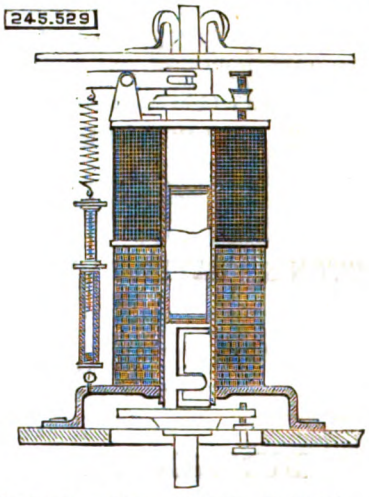
Claim.—(1) In a magneto-electric machine an armature of iron in the form of a ring or endless band, having its greatest length of cross-section parallel with its axis, said armature built of sectional pieces, B, secured together and held to the central hub, C, and provided with lugs or fillets, substantially as described. (2) A magneto-electric machine having an armature in the form of a ring or endless band, with its greatest length of cross-section parallel with its axis, and the mag-



net poles enclosing the armature externally, and having branches extending within at both ends, substantially as herein shown and described.

245,529. ELECTRIC LIGHT REGULATOR, *William H. Markland and Wyllis H. Markland, Brooklyn, assignors to the Empire Electric Light Company, New York, N.Y.—Filed May 10th*, 1881.

Brief.—The carbon passes through the hollow core of an electro-magnet. The lower end of said hollow core is split into two sections hinged together at one end. When a current passes these sections are so polarised that their free ends are of the same polarity and are mutually repelled, thereby gripping the carbon. *Claim.*—(1) The combination, substantially as hereinbefore set forth, of a hollow helix and a hollow core movable



longitudinally within said helix, divided longitudinally into sections, which sections are united by a hinge. (2) The combination, substantially as hereinbefore set forth, of a hollow helix, a hollow core divided longitudinally into sections, which are united by a hinge, and an electrode or rod for holding the same passing axially through the hollow core, which is clamped between the sections thereof when the helix is traversed by an electric current. (3) The combination, substantially as hereinbefore set forth, of a cylindrical carbon electrode, or a rod for holding the same, a longitudinal groove formed in one side of said electrode or rod, and a guiding wheel having a periphery of V-shaped section.

THE SCHOOL OF SUBMARINE TELEGRAPHY & OF TELEPHONY.

ESTABLISHED IN 1868.

4, GEORGE STREET, HANOVER SQUARE, LONDON, W.

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The course of Practical and Theoretical Instruction in the higher branches of Overland and Submarine Telegraphy embraces, in addition to the manipulation of the various systems of working in general use, the following subjects:—

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METHODS of TESTING the ELECTRICAL CONDITION of a LINE During and After its Construction.

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The instruction, both in signalling and testing, is of a thoroughly practical character, as the classes work with the actual instruments used on long lines, through cables of various lengths, from 600 to 3,000 knots, so that the signals of the Eastern, Atlantic, and Brazilian Co.'s, &c., are exactly reproduced, and the pupils fitted for any line.

A Course of Instruction in the Fitting up, working, and Testing of TELEPHONE CIRCUITS has now been added to, and embodied in, the ordinary curriculum, including all the forms of TELEPHONES, the various switch board arrangements and EXCHANGE SYSTEMS in general use.

Further information can be obtained on application to the SECRETARY.

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ADDRESSES.

M. THEILER & SONS, Manufacturing Electricians,
86, CANONBURY ROAD, LONDON, N. Factory: 1, Alwyne-lane, N.
Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
THEILER'S PATENT TELEPHONE TRANSMITTER, with Sensitive Bell, &c. Complete, price £3 10s.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

NEWTON'S PATENT LAW and PRACTICE, Price 2s. 6d.
This standard work contains all legal and other information necessary for intending patentees, including Government charges, agency fees, and rules of the Commissioners of Patents.
TRUBNER and Co., Ludgate-hill, and may be obtained at the Office for Patents, 66, Chancery-lane, W.C.

DUNCAN WALLET & CO.,
BONDED STORE AND PROVISION MERCHANTS,
15, BILLITER STREET, LONDON.

Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

VULCANITE.
HARBURG INDIA-RUBBER COMB COMPANY.
LONDON WAREHOUSE: F. WINTER.
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EBONITE.

JOHNSON'S PATENT TRANSMITTER,
IN COMBINATION WITH
BELL'S EBONITE TELEPHONE.

Unequalled for Telephone Exchange or Private purposes.

ALL ROYALTIES PAID.

TASKER, SONS & CO.,
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ELECTRIC LIGHT.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

HARBOROW & CO.,
ELECTRIC LIGHT ENGINEERS
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TELEGRAPH INSTRUMENT MANUFACTURERS,
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ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

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Southampton-buildings, Chancery-lane

NEWALL'S PATENT LIGHTNING CONDUCTORS.

Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

SOLE PATENTEES OF UNTWISTED WIRE ROPE.

Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c.

Gilt and Silver Cord for Hanging Pictures. Iron, Steel, and Copper Cord for Clock and Sash Lines, &c.

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SLIP

ELECTRIC LIGHT IN RAILWAY STATIONS.—Farringdon-street Railway Station, in the City, is now lighted by electricity.

ELECTRIC LIGHT IN IRONWORKS.—Messrs. R. Hornsby and Sons, of Grantham (Lincolnshire), have adopted the Brush system for their ironworks.

AURORA BOREALIS.—News from the North of Scotland says that there was a brilliant display of the Aurora Borealis on the evening of Sunday, the 16th October.

WEST INDIES.—The cable between Pernambuco and Bahia is interrupted, and during the interruption all telegrams for Brazil will be forwarded by the route of the Brazilian Land Lines.

ELECTRIC LIGHTING AT GREENOCK.—The Greenock Police Board have resolved to promote a Bill in the approaching Parliamentary Session to obtain powers for lighting the town by electricity.

RAILWAY TRAINS AND ELECTRIC COMMUNICATION.—It is stated that the Government of New South Wales are about to make trial of an electric system of intercommunication in railway trains.

SS "GREAT EASTERN."—This vessel was offered for sale last week at Lloyd's; the bidding began at £20,000 and went up to £30,000. As no higher bid than this was received she was not sold.

INDO-EUROPEAN TELEGRAPH COMPANY.—The directors of this company have declared an interim dividend for the half-year ending June 30 last, at the rate of 5 per cent. per annum, free of income-tax.

INSTITUTION OF CIVIL ENGINEERS.—This institution is now in telephonic communication with the exchange system of the United Telephone Company, and its registered telegraphic address is "Institution, London."

GREAT NORTHERN TELEGRAPH COMPANY.—The number of telegrams passing over the lines of this company in the first nine months of this year was 788,211, as compared with 749,285 in the corresponding period of 1880.

THE SOCIETY OF ARTS.—The first meeting of the 128th session of this society will be held on Wednesday, November 16, when the opening address will be delivered by Sir Frederick J. Bramwell, F.R.S., chairman of the council.

THE TELEPHONE IN BERLIN.—It is stated that up to the 1st of the present month no less than 533 houses in Berlin were connected by telephone, and that the total length of telephonic wires in Berlin at that date was about 750 miles.

SECONDARY BATTERIES.—Professor W. G. Adams, F.R.S., gave a lecture in the early part of this week, at King's College, on Grove's Planté's, and Faure's secondary batteries. We shall hope to give an abstract of this lecture in a future issue.

ELECTRIC LIGHTING FOR FULHAM.—A meeting of the Works Committee of the Fulham District Board of Works was to be held on Thursday last to consider the tenders sent in for lighting certain parts of their district by electricity. We have not yet heard the result.

ELECTRIC LIGHT FOR THE MANSION HOUSE.—The Court of Common Council have finally accepted the tender of Messrs. R. E. Crompton and Co. to light the saloon and the Egyptian Hall at the Mansion House. We gave details of the tender in our last issue, page 354.

THE TELEPHONE IN MEXICO.—It is announced that the Mexican Telephone Company has been formed in New York, with a capital of 500,000 dollars. The company hopes to obtain a subvention from the Mexican Government for working the telephone in that country.

THE TELEPHONE IN TURIN.—The International Bell Telephone Company are busily engaged in extending their telephonic operations in this place. We understand that some 150 subscribers are already connected, and that another 75 or 100 will be connected next month.

LIGHTING OF THE NEW LAW COURTS.—It is stated that the question of lighting the New Law Courts is still undecided, the decision lying between gas and electricity. It was originally determined to use gas, but we believe that the work of laying the pipes has been suspended.

LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY.—The revenue of the London Platino-Brazilian Telegraph Company for the month of July, 1881, is estimated at £1,694 (Western and Brazilian portion £1,213, land lines £481), as against £1,886 for the corresponding period of last year.

THE TELEGRAPH AND BANKING OPERATIONS.—The report of the Chartered Mercantile Bank of India, London, and China says that the profits of the bank have been decreased by the transactions which take place through the telegraph; but, on the other hand, it gives them greater security.

PARIS ELECTRICAL EXHIBITION.—We learn that Sir A. Clarke, K.C.M.G., President of the Royal Engineer Committee, accompanied by Major Armstrong, Professor in Electricity, and Captain Barker, secretary, left Chatham on Tuesday, to attend the Electrical Exhibition at Paris.

DIRECT UNITED STATES CABLE COMPANY.—The directors have resolved upon the payment of an interim dividend of five shillings per share, being at the rate of 5 per cent. per annum for the quarter ended 30th September, 1881, such dividend to be payable on and after the 16th November next.

ELECTRIC LIGHT FOR PICTURE GALLERIES.—We hear that Mr. Nettlefold, of Birmingham, has presented paintings worth £25,000 to £30,000 to that town, on the express condition that they are placed in a gallery lighted with the electric light, and open Sunday and week-day alike till 8 p.m.

THE SHETLAND CABLE.—The "Dacia" arrived at Sandwick Bay on Wednesday morning, having completed the relaying of the Orkney and Shetland telegraph cable, which has been interrupted since March 5. Communication is now restored. The "Dacia" has been very much delayed by the recent gales.

INDICATORS OF WATER LEVELS.—In *La Lumière Electrique* for the 22nd October, M. le Comte du Moncel continues his series of articles on the various apparatus for indicating the rise or fall of the water of rivers or lakes, &c. In the present article he describes the systems of Mocquery, Hasler, Golfarelli, and Grivolas.

EASTERN EXTENSION TELEGRAPH COMPANY.—The coupons on the Eastern Extension Australasia and China Telegraph Company's Manilla Five per Cent. Debentures, due on the 1st November, will be paid at the Consolidated Bank, 52, Threadneedle-street, E.C. The coupons should be left three clear days for examination.

THE ELECTRIC LIGHT FOR WESTMINSTER.—The *Westminster and Chelsea News* says that the Westminster District Board of Works have resolved to obtain tenders from the electric lighting companies to ascertain the cost of lighting Parliament-street, the Broad Sanctuary, and Victoria-street, by this system of lighting.

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A German Telegraph School.—According to a notice recently issued by the Secretary of State for the German Post Office, the Telegraph School at Berlin will shortly commence another session of six months, lasting until April. Here *employés* of the telegraph service may undergo a course of physics, chemistry, mathematics, &c.

Electrical Exhibition at Cockermouth.—It is intended to hold an exhibition of electrical and telephonic apparatus at Cockermouth from the 23rd to 28th November, in connection with the Art and Industrial Exhibition of the Public Hall Company. No charge will be made for space. Communications should be addressed to Mr. J. H. Watson, Cockermouth.

The Telephone in Preston (Lancs).—The Board of Guardians of Preston, having resolved to establish telephonic communication between their workhouse at Fulwood and the offices, have entrusted the work to Mr. G. Sharples, of Preston. The Johnson transmitter is to be used, the guardians preferring this to the Bell or Blake transmitters. The distance of the proposed line is two miles.

International Electrical Exhibition. — Date of Closing.—At a meeting of the Foreign Commissioners held in Paris on Wednesday last, M. Berger, the Commissioner-General, stated officially that the Exhibition will be closed to the public on the 17th November, two days being added (for the benefit of the poor and other charitable purposes) to the originally intended date, the 15th November.

Electric Breaks for Railway Trains.—The French Eastern Railway Company lately made trial of the Achard electric break fitted to a train running between Chateau-Thierry and Chalons. It is stated that the average speed was 90 kilometres per hour. When running 96 kilometres per hour the break brought the train to a standstill in a distance of 270 metres, and once it is stated that the distance run after application of the break was only 190 metres.

The Gales and Cables.—During the recent heavy gales a cable of the German Union, one of the Great Northern, and four of the Eastern Telegraph Company's cables were broken. These damages are all in shallow water, and, therefore, will be comparatively easily repaired. We understand that three ships of the Eastern Telegraph Company—the "Kangaroo," the "John Pender," and the "Retriever"—are engaged in the work of repairing at their several stations.

Electric Light in South Africa.—It is proposed to apply the electric light at the Railway Terminus, House of Assembly, and other buildings in Cape Town; and the Table Bay Harbour Board have asked Sir John Coode's advice on the subject of illuminating the entrance to the harbour by this means. Sir John has reported in favour of the proposal, and recommends that tenders should be invited from the principal electric light companies in England.—*Colonies and India.*

Tenders Wanted for Electric Lighting.—The Greenock Harbour Trustees are inviting tenders for lighting by electricity a portion of their harbours, quays, and sheds during some of the winter months. Forms of tender and full particulars may be obtained of Mr. W. R. Kinniple, C.E., engineer to the trustees, Greenock. Tenders, sealed, and endorsed outside "Tender for Electric Lighting," are to be sent to Mr. Thos. Wilson, clerk to the trustees, Greenock, by the 16th of November.

Prices.—The prices as quoted this week are:—For gutta percha per lb.:—Good to fine, 1s. 8d to 3s. 6d.; low to medium, 3d. to 1s. 7d. India rubber, per lb., fine Para, 3s. 4d.; negrohead, 1s. 11½d. to 2s.; central American, 1s. 7d. to 2s. 3d. Assam and Pegu, 8d. to 2s.; other East Indian, 1s. 2d. to 2s.; Madagascar and Mozambique, 1s. 8d. to 2s. 3d. The above prices are all below those ruling at the same date last year, with the exception of Madagascar and Mozambique, which was quoted at 1s. 7d. to 2s. 3d.

Paris Exhibition.—Presentation to MM. Cochery and Berger.—The foreign commissioners of the International Electrical Exhibition and the foreign members of the Congress on Electricity and of the Prize Jury, met on Tuesday last, at the Palais des Champs Elysées, to present a work of art each to M. Cochery, Minister of Posts and Telegraphs, and to M. Georges Berger, Commissioner-General, as a souvenir of the Exhibition. Mr. Warren de la Rue acted as spokesman, and delivered an appropriate speech in making the presentations. MM. Cochery and Berger expressed their thanks in cordial terms.

Literature.—The current number of the *Quarterly Review*, just published, contains an article on the "Development of Electric Lighting." In the July number of the same periodical is an article on earthquakes, in which the writer endeavours to trace their origin and cause to electricity. The undulatory motions are supposed to be the result of electricity endeavouring to break through cushions of soft, non-conducting materials, and the cracks and chasms opened in the soil are put down to the power of the electric jet to rip asunder the surface. We believe seismologists in general do not agree with the author of this latter article.

A Telegraphic Street Directory.—A correspondent, writing to the *Daily News* from Milan, urges that the Post Office authorities should issue a "London Telegraphic Street Directory" for its own and the public use. "I often," he says, "have to pay 2s. 11d. for the address on a telegram when 1s. 3d. would be sufficient if each street in London had its telegraphic name, in the same way that most London houses of business have theirs, consisting of one simple word. I need not point out how much time would be gained in the transmission of inland messages, where the address, not being charged for, is generally written out in full."

Leonardo da Vinci.—In a letter to the President of the Académie des Sciences, relating to the scientific discoveries of Leonardo da Vinci, M. Ch. Ravaisson writes, speaking of Da Vinci's scientific writings, which he is editing:—"We meet with a description of a mode of perceiving distant sounds similar to many of those which were constructed with the same object before the invention of the electric telephone. If you stop your boat, put the end of a tube in the water and the other end to your ear, you will hear the boats at some distance from you; and if you put the end of a tube in the earth, and in the same manner to your ear, you will hear what passes afar off."

The "Hooper."—This fine vessel, specially suited for cable work, has, we understand, been purchased by the India Rubber, Gutta Percha, and Telegraph Company from Messrs. Hooper, and will be employed in laying the South American Cables, now being manufactured. It is expected that the ship will leave for the Pacific Coast in March next. Her tonnage and measurements are—length over all 350ft., beam 55ft., moulded depth 36ft., gross tonnage 4,935 tons, net register 3,724 tons. She has three cable tanks, each 30ft. deep, with diameters respectively 41ft., 53ft., and 51ft., and has the usual cable gear. The "Hooper" is the largest cable ship afloat. It is the intention of the present owners to call her the "Silvertown."

Underground Telegraph Lines.—A weekly contemporary says:—"A new metal is proposed in which to con-

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struct pipes to lay telegraph wires underground, and is described as very light—only about one-sixth the weight of iron—and, being composed almost entirely of pure carbon, is indestructible. Whether in the air or underground, it does not rust or change by exposure, and is not affected by heat or frost. The most important characteristic claimed for it, however, in connection with underground wires, is its being a perfect insulator. The pipes of the metal need not, it is stated, be buried very deep in the ground, as they may be of a semi-elastic character, adjusting themselves to the slight upheaval and depression of the ground through the action of frost."

Selenium and the Photophone.—Dr. Kalischer, who has been experimenting on selenium cells for the photophone, confirms the observations of Adams and Day that light may in certain cases set up in these cells a photo-electromotive force, the cell becoming its own battery. The same experimenter draws attention to a curious point, namely, that the sensitiveness of selenium cells to light is often greater in cells of high resistance than in those in which, by annealing, the resistance has been greatly reduced. A single cell kept for some months gradually lessened in resistance while becoming less sensitive to light. These anomalies Dr. Kalischer attributes to the allotropic modifications through which the substance passes, the want of homogeneity accounting also for the photo-electromotive forces observed. *Nature.*

Cable Work at Silvertown.—The India Rubber and Gutta Percha Company is at present manufacturing 3,100 miles of cable for the Central and South American Telegraph Company of New York. They are also manufacturing 300 miles for the West India and Panama Telegraph Company. The ss. "Dacia" and "International" should leave the Thames with portions of this cable on board about the middle of next month. The first-named ship is going to the Pacific side, and the second to the Gulf of Mexico. The "International" carries Mr. Theophilus Smith as engineer-in-charge, and the "Dacia" Mr. W. F. King (late of Western and Brazilian Company) as engineer-in-charge, with Messrs. March Webb and G. K. Gray as assistants. Mr. M. H. Gray goes out in charge of the "Silvertown." We hope to give the sections, &c., of these cables in a future number.

Telegraph Construction and Maintenance Company.—Notice is given that the 13th distribution on the certificates of this Company, issued under the trust deed of the 12th March, 1875, will be made on and after the 1st November, 1881. The distribution, which arises from dividends on the shares held by the trustees, will be at the rate of 1s. 2d. per £5 certificate, payable two clear days after presentation of coupon No. 13, at Messrs. Barclay, Bevan, and Co.'s Bank, No. 54, Lombard-street; and also, that all certificate holders who have not received the return of capital at the rate of £2 10s. per £5 certificate, declared in August last, can obtain payment on lodging the certificates at the above bank. The further supplementary sheets, containing six coupons, numbered from 13 to 18, may be obtained by such certificate holders as have not already had them, upon production of their certificates at the offices of the Company, 38, Old Broad-street, London, E.C.

An Electric Gas Lighting Company.—A company with the title of the London and Provincial Electric Gas Lighting Company has lately been started. Its objects are to acquire and work inventions, patented or otherwise, for the lighting of gas by electricity, or any interest in such inventions; and in particular to acquire from the Electric Gas Lighting Company (Limited) a certain licence for the exclusive manufacture and vending of the patent electric lamp called the "Firefly," and all improvements in relation thereto. The capital is £22,000, in £1 shares. Signatories (with one share each):—W. W. Strode, 48, Osnaburgh-street, W.; E. P. Williams, same address; B. P. Bidder, Dashwood House, 9, New Broad-street; P. D. Roddy, Westminster Palace Hotel, S.W.; Sir E. J. Reed, K.C.B., F.R.S., M.P., Broadway-chambers, Westminster; J. Leigh, Alderley Edge, Cheshire; C. L. Clarke, Dantzic-place, Manchester. The following are also directors:—Mr. W. Milne and Mr. J. Mackenzie.

Railway Telegraphs in a Gale.—A correspondent draws a vivid picture of the possible dangers which, despite the block system, may beset the travelling public in a gale. He says:—"It is instructive to think what becomes of all this system (the block system) in a gale. Not only is it scattered to the winds in every sense, but as if the unfortunate engine drivers have not enough to do when they are deprived of the usual signals and have to cross cut timber and boughs of trees as they come upon them without warning, they run an additional risk from the tangles of posts and wires which are blown across the permanent way. What the consequences might be at night were a coil of broken wire to cut the heads of driver and stoker off, or pull them from their engine, is very easy to imagine; and I think a little reflection on the part of the travelling public will gain them over to advocate the necessity for placing telegraph wires along our railroads underground, as the Germans are about to do, instead of overhead."

Electric Light Wires and Gas.—At the last meeting of the Commissioners of Sewers a letter was read from the Gas Light and Coke Company, calling attention to statements which had recently been made as to the probability of accident arising from the wires used by the electric lighting companies for the conveyance of electricity. It had, for instance, been represented to the directors that in the event of the electric wires being laid in the subways containing gas mains, whence from any cause a leakage of gas should proceed and there was any defect in the insulation of the wires, the gas might be fired and an explosion arise. The directors had no intention of submitting any proposal on the subject, but they deemed it to be their duty to bring it under the notice of the commission. The letter was referred to a committee for consideration. Replying to a question, the chairman of the Streets Committee said the trial of the electric light in the City had not been thought sufficient at present to justify them in recommending its extension.

The Electric Light and Gas.—On the occasion of the opening of the new gas works recently built by the Local Board of Smethwick, near Birmingham, reference was naturally made in the speeches subsequent to the opening ceremony to the electric light, and, contrary to the usual custom nowadays, these speeches were moderate in tone and eminently practical. One gentleman is reported to have said that "he did not by any means regard the electric light as an uncompromising enemy. It was well ascertained that for the production thereof they could not have better machines than gas engines. Here there was open to them a considerable future for gas making." Again, another gentleman said:—"Personally, he was not at all alarmed at the prospects before them. The future of gas was not dependent upon its use for lighting, although he thought that for a good many years to come it would have much to do in this direction. But, if electricity was successful, it would probably have to make use of its rival, gas, even for its own creation. The gas engine would be one of the most efficient

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and economical means of evolving electricity, and it seemed quite as certain that gas would be the fuel of the future as that electricity was to be the coming light."

New Galvanometer.—At a recent meeting of the French Academy of Sciences, M. A. Gaiffe described a new form of galvanometer constructed by him, in which the beats are proportional to the intensity of the current. M. Gaiffe said:—"In 1876 I had the honour to submit to the Academy a Siemens induction machine, in which I had succeeded in making the currents almost continuous, by substituting for the cylindrical Siemens coil a coil of eliptical section. Acting on the same principle, I have endeavoured to render the angular beats of ordinary galvanomaters proportional to the intensities of the currents. It will be readily understood that it is possible to give to a multiplier dial such a form that its influence on the needle increases, for currents of increasing intensity, as the directive action of the earth, when horizontal galvanometers are used, or as that of counterweights when vertical galvanometers are used. The instrument which I have the honour of laying before the Academy is a horizontal galvanometer graduated to milliamperes, the multiplying dial of which is of eliptical form. This is designed for medical uses. The beats are regulated for two angles of about 35 degrees, representing 35 milliamperes on each side of zero, and diminishing by slow degrees down to 1-50 of a milliampere. Experiments made lately with a curve of a different kind have shown me that proportional beats can be obtained up to about 75 degrees on each side of zero."

Meteorological Suggestions.—Speaking of the recent gales, Mr. C. L. Wragge, of the Ben Nevis Observatory, writes to *The Times* as follows:—"Considering the late disastrous hurricane, and the great rapidity with which cyclonic storms advance over us from the Atlantic, often yoked together, of what immense value to the seafaring and agricultural communities, and the public at large, would be—first, the mooring of a ship or buoy, specially constructed, about 500 miles to the west of Ireland, fitted with self-recording instruments and connected by cable with the coast, as has been before suggested; secondly, the establishment of high-level meteorological observatories on selected spots in these islands; thirdly, the connecting of our chief meteorological reporting stations with the head office in London by means of underground cables. . . . Had we subterranean cables directly in connection with Victoria-street (my own suggestion), our Meteorological Office would not be crippled through want of information, in consequence of wrecked telegraph lines, as has just been the case; but its system would be in an efficient condition, despite any purely atmospheric disturbance, on occasions when we most require its services. At any rate, Valentia should be connected with the office by underground lines, as a preliminary, and so we should be sure of reports from a valuable outpost station. . . . To anchor a ship in 'blue water' may be at present impracticable; but high level stations and subterranean cables can and ought to be established." Our readers will find this subject referred to in *The Electrician*, Vol. VII., No. 16, p. 248, and No. 12, p. 184, also in Vol. VI., No. 21, p. 260.

Telegraph Stamps.—The assimilation of the penny adhesive stamps for Postal and Inland Revenue charges having been received by the public with much satisfaction, it has been decided to proceed further in the same direction, and to abolish the distinctive stamps now used for the payment of the charges upon telegraph messages. On and after the 1st November, therefore, the use of distinctive telegraph stamps will be discontinued, and postage stamps of all amounts, including the penny postage and inland revenue stamp, will be available for the payment of telegraph charges. This measure will facilitate the posting of telegrams in letter-boxes during the night, or where there is no telegraph office within a convenient distance, as telegrams thus posted will be conveyed without extra charge at the next collection of letters to the nearest telegraph office which is open, for the purpose of being transmitted by the wires at the earliest possible moment. In those cases in which difficulty would be experienced in obtaining a printed telegraph-message form ordinary paper may be used. The message may or may not, at the option of the sender, be enclosed in an envelope, but if an envelope is used it must be marked "Telegram—immediate." The stock of telegraph stamps and stamped telegraph forms in the hands of the public may still be used for telegraph purposes, but not for postage or inland revenue payments.—A correspondent of a daily contemporary writes as follows on this subject:—"When the ordinary postage and receipt stamps are made available for payment of telegraph messages an alteration in the present telegraph forms will be required, for it is impossible to affix twelve to eighteen penny stamps to one of the forms now in use without covering a large portion of the printed matter. If the public have to keep a supply of shilling, sixpenny, and threepenny stamps the benefit of the change will be lost. By condensing that portion of the present form which is used for the service, and leaving a space of one inch deep along the top, twelve penny stamps might be affixed to a form."

Crystal Palace Electrical Exhibition.—On Monday last a meeting was held at the Mansion House, under the presidency of the Lord Mayor, for the purpose of constituting the honorary council to advise with the directors of the Crystal Palace in carrrying out the International Electric Exhibition which it is proposed should take place there. Amongst those present were Mr. John Holms, M.P., Sir James Anderson, Captain Douglas Galton, Mr. H. G. Erichsen, Dr. Gladstone, Dr. C. W. Siemens. Mr. Deputy M'George, chairman of the Crystal Palace Company, in proposing a number of names as the honorary council, said the directors of the Palace were fully alive to the importance of the exhibition, both from a scientific and commercial point of view. No guarantee fund was required, but, considering the interest which this question of electricity was to the country at large, it was hoped that the City guilds, the large societies, and others would come forward with gold medals. This he would promise on the part of the judges, that only scientific excellence of the highest form should receive them. Major Flood Page read the report of the directors of the Palace, which stated that communications had been opened with the leading exhibitors at the Electric Exhibition in Paris, and with others who had made the development of electricity their special study. Although but a very short period had elapsed since the first steps were taken, the responses had been such as to render it certain that an effective and varied display would be made at the Crystal Palace. Most of the best known systems of electric lighting would be represented, and various new lamps would be exhibited for the first time in public. The storage of electricity would, it was hoped, be illustrated by Faure's and De Meriten's secondary batteries, and telephones, which were not nearly so much used in England as elsewhere, would be strongly represented; and the various applications of electricity as a motive power would be seen in Trouvé's boats and other interesting exhibits. Many eminent scientific men had expressed great interest in the undertaking, and intended to become exhibitors.

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THE ELECTRICAL EXHIBITION AT PARIS.

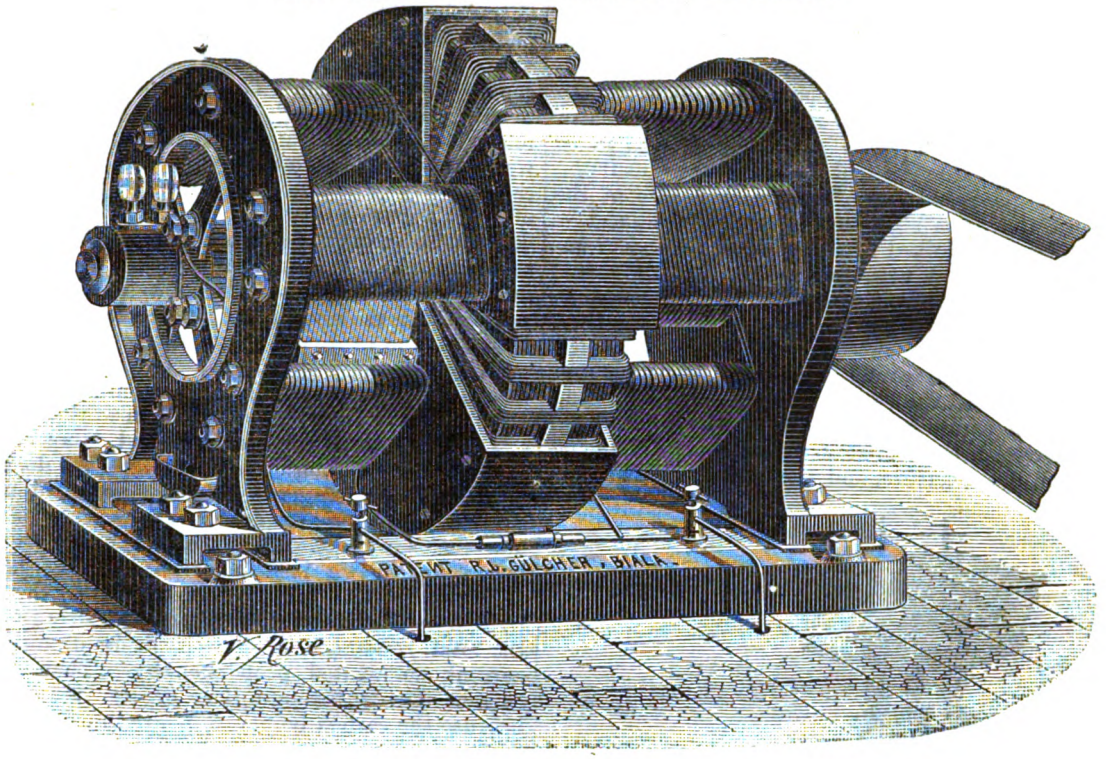

FIG.

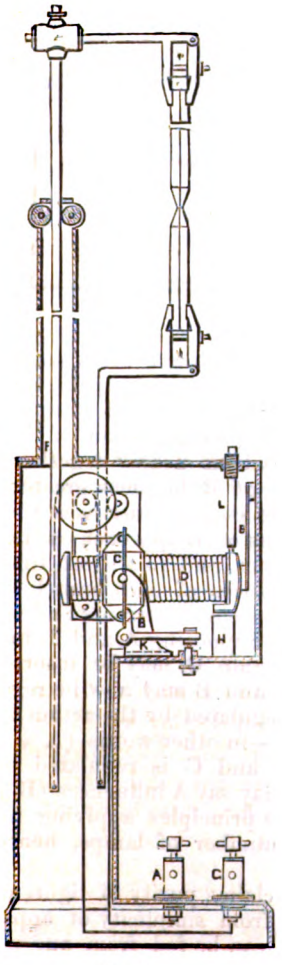

FIG. 2.

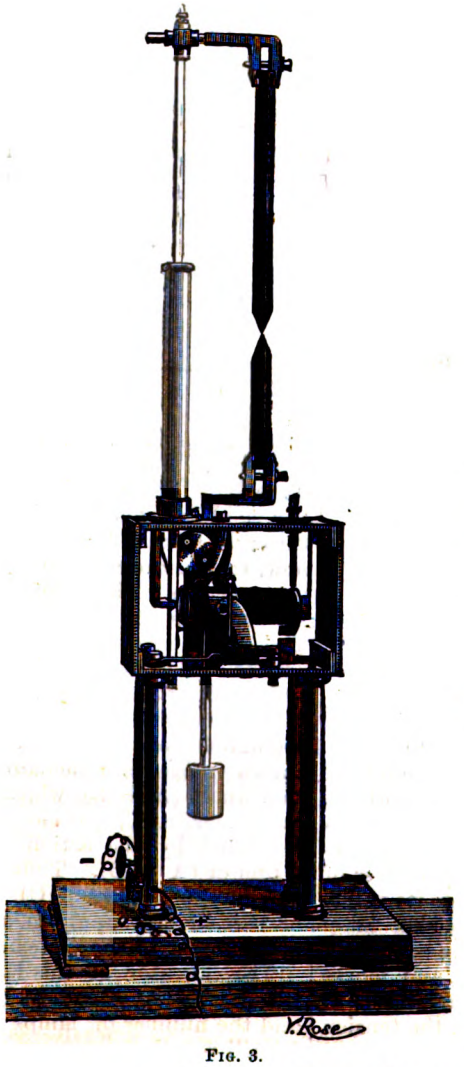

FIG. 3.

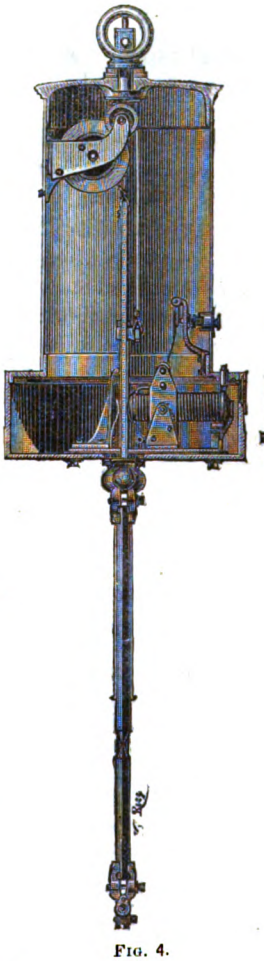

FIG. 4.

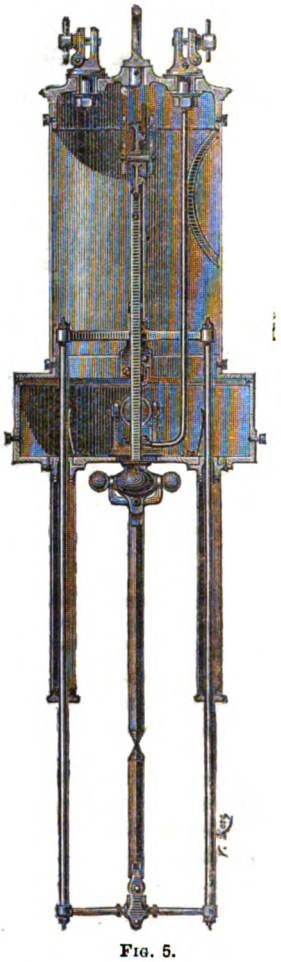

FIG. 5.

ELECTRIC LIGHT APPARATUS.

GÜLCHER'S MACHINE.—In the Austrian Section is a machine to which, we are informed, the jury have awarded a gold medal—designed by M. R. J. Gülcher, of Biala, Austria. M. Gülcher also exhibits a new lamp which is said to have

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been similarly favoured by the jury. The machine, which we herewith illustrate, is designed with a view to produce currents of great quantity and low tension, a result obtained, we should imagine, almost to perfection also by some of the machines shown by Siemens and Halske in the German Section. In the Gülcher machine there are four pairs of field magnets placed side by side, coiled with insulated copper cord. The opposite poles, *i.e.*, on each side of the armature, are of the same sign, thus + opposite +, and − opposite −. These are joined to a ⊓ shaped pole piece encircling a large part of the actuation ring. By this means the inventor claims the inductive action of the poles to influence the periphery as well as the sides of the armature. The armature itself is, to all intents and purposes, a Pacinotti ring, and is kept cool partly because of the action of the air, the armature and the ⊓ shaped pole pieces forming a powerful fan, and partly because of the method of coiling. It will be understood that there are four reversals during one revolution of the armature, and the currents are taken

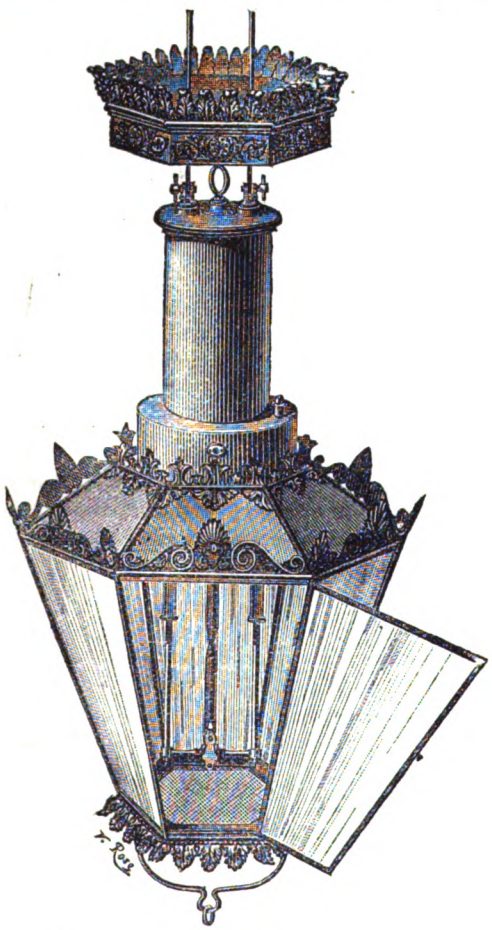


Fig. 6.

from the commutation by the brushes, and sent to line. The internal resistance of the machine shown at Paris is given as 0·12 ohm. The commutator is made of large area to obtain better contact with the brushes, to reduce wear, and prevent sparking, and so far as we could gather from its work at Paris it runs easily and keeps cool, but it was not called upon to exert its full powers. The jurors, no doubt, will give us exact figures obtained by them in testing the capabilities of this machine, when we shall be better able to judge its value.

Besides his machine, M. Gülcher shows a very neat lamp of the arc type. The upper and lower carbons are connected by cords. The upper carbon holder F is of iron, and moves in front of the electro-magnet D. The polar surfaces of D are rounded off as shown. By means of a spring, the tension of which can be regulated by the lever K, the electro-magnet is pressed against the stop L. Suppose a current to be passing through the lamp, one pole of D would hold fast the armature F, whilst the other pole would be drawn towards the iron block H, the electro-magnet moving about the point C, and by this means the arc is formed. As the carbon pencils burn away the magnet D is again drawn back, and finally rests against the stop L, where it remains whilst the conditions are normal. The carbons, however, are constantly burning, and the length of the arc increases, thus increasing the resistance and weakening the current, which weakens the electro-magnet, and F is then released, causing the carbon to fall. In order to regulate the action of the apparatus at the lighting of the lamp, and to obviate too great a jerk, one pole of the electro-magnet is acted upon by a brake, J, which is said to answer better than a flyer set in motion by a clockwork arrangement. The electro-magnet after the arc is made, as we see, rests against the stop L, but it is in readiness to correct any abnormal length of arc.

Figures 2 and 3 show perspective views of a new model of this lamp for laboratory purposes, whilst Figures 4, 5, and 6, show a lamp as suspended for use in workshops, &c.

The designer of this machine and lamp claims to have a special way of arranging his circuits. We did not see in the Exhibition any number of lamps arranged in the manner suggested, and give the description as given to us. We may, however, say at once that it is not new. In Fig. 7, "Two lamps are shown in this arranging, one lamp being the regulator of the other. Suppose, first, the lamp A to be lighted by closing its circuit, then by closing the circuit of B the total resistance of the circuit is diminished, and the current augmented proportionally. That portion of the current flowing through B is greater than that through A, because the carbon points of B are in contact, and the resis-

Fig. 7.

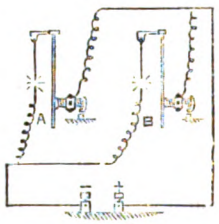
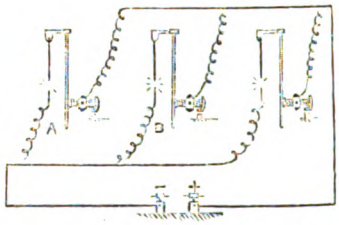


Fig. 8.



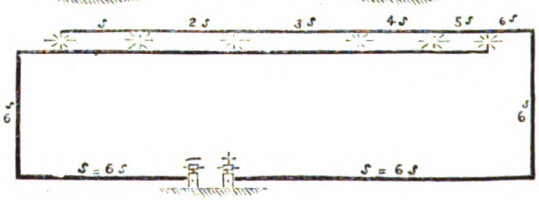


Fig. 9.

tance of this branch is, therefore, less than the resistance of the other. But the action of the magnet of lamp B separates its carbons, and thus increases the resistance of that branch, and so of the whole circuit, causing a diminution of current through A, and bringing its carbons nearer together. If, now, the distance of the carbons of B becomes greater than that of the carbons of A, the current increases through A, and acts so that the carbons of B approach each other. Thus the lamps regulate each other, and in a short time the arcs of each lamp, and the resistances of each branch circuit are equal, hence the lamps receive equal currents and should give equal and steady lights. Supposing A and B to have regulated themselves, a third lamp, C, may be inserted, as shown in Fig. 8. The lamps A and B may now be regarded as a whole (A + B), which is regulated by the action of the branch circuit C, and *vice versâ*—in other words (A + B) is regulated by the action of C, and C is regulated by the action of (A + B). Thus we may say A influences (B + C), and B influences (A + C). The principles applying to two or three lamps apply to any number of lamps, hence the applicability of the system."

The inventor of this lamp claims purity of light, steadiness, and great economy, both from simplicity of apparatus and the number of lamps that can be fed from one source. It still remains to mention the method adopted to obtain a symmetrical division of the current among the lamps. This division depends upon the equality of resistance of the branch conductors. M. Gülcher's arrangement to obtain this equality is as follows:—"Directly the number *m* of

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lamps which the machine is to feed, as well as the total lengths of the circuit, are known, the diameter D of the wire is calculated for the principal current S, then the diameter d is calculated from the formula $\frac{\pi D^2}{4} = \frac{m \pi d^2}{4}$ or $d = D \sqrt{\frac{1}{m}}$, and forms, from m wires of the diameter d, a rope or cable which has the same conducting power as a wire of diameter D. This cable is connected first with one pole of the source, and then led to the first lamp, where, as shown in the Fig. 9, a wire branches off through the lamp, and is then led on parallel to the remaining $m - 1$ wires. At the second lamp a second wire of the cable branches off, which, after it has been led through the lamp, unites with the wire coming from the first lamp. At the third lamp a third wire branches off, and is united to the two wires coming from the second lamp. This goes on till the last wire at the mth lamp is united to the $(m - 1)$ wires coming from the $(m - 1)$th lamp, so as to form again a cable of m wires leading to the other pole of the source. It is easy to perceive that the resistance of the conductors for each lamp must now be equal; for on simple geometrical grounds the lengths of the circuits of all partial currents, as shown in the diagram, Fig. 9, are equal to one another, and, further, the section of the conductor at each point corresponds exactly to the current passing. As the main current is equal to m divided currents, s may be taken as representing each, so that $S = m\ s$, then the current through the main conductor to the first lamp $= S = m\ s$, from the first to the second lamp $= \frac{m-1}{m} S = (m-1)\ s$, from the second to the third $= \frac{m-2}{m} S = (m-2)\ s$, and so on; similarly the section of the conductor becomes less, because a cable of m wires of diameter d loses one wire at each lamp, which, however, is led into the return wire, increasing that in the proportion required."

The system has, we understand, been hitherto employed only in the inventor's own establishment, as he wished to thoroughly perfect and test his work before offering it to the public. As we have said, both lamp and machine have been awarded a gold medal at the Exhibition. The lamps are made to give lights from 250 candles, and similarly the machines are designed for the work for which they are intended. The inventor states that "the quantity of light can be divided as required without any loss." Thus one machine of 6,000 candles will feed a single lamp of that power, or two of 3,000 candles, and so on up to 24 of 250 candles each, the machine absorbing about one horse-power for every 600 candles. The cost of the apparatus at Paris is given at £80 for the 6,000 candle-power machine, the lamps of 1,000 candles at £7 each, and the lamps of 500 candles at £4 each; but it is presumed that if manufactured on a moderate scale, this cost would be reduced.

THE CONTACT THEORY OF THE VOLTAIC CELL.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I generally read *The Electrician* pretty carefully every week; but somehow I missed seeing the letter of Mr. J. Brown in your issue of the 15th instant. In reply to that gentleman I beg to state that although I have never *directly* observed the difference of tensions between hydrogen and copper in contact (and unfortunately my electrometer is just now not in working order), still, I cannot suppose that these two metals constitute in their relation to each other an exception to the general law that any two conductors (non-gaseous hydrogen may be classed amongst good conductors, and the gas has amongst gases a comparatively low specific resistance) exhibit an electroscopic difference when brought into contact. It is true that hydrogen and copper are very close together—in fact, nearly, if not quite, next-door neighbours—on the electro-chemical scale; but when it is considered that the grain-equivalent of hydrogen (considered as an oxidisable body) contains potential energy to the value of 6,840 foot pounds, whilst the grain-equivalent of copper contains only 4,340 foot pounds, it is tolerably evident that our present electrometrical appliances should be fully competent to exhibit the corresponding contact-difference. By the way, all our text books, following the example of Berzelius, stupidly place hydrogen quite at the electro-negative end of the scale, beyond platinum and gold. How long shall we endure such teaching!—Yours, &c.,

DESMOMD G. FITZGERALD.

THUNDERSTORMS AND TELEPHONIC DISTURBANCES.—In a note on this subject recently communicated to the French Academy of Sciences, M. de Lalagade says:—"With reference to a recent communication from M. Colladon, touching M. Thury's experiments on the noises produced in a telephone during thunderstorms, I ask permission to again bring before the Academy my researches on the same subject which I had the honour to lay before it on the 5th of August, 1878. In June, 1878, when I was engaged in laying a telegraph line of some 800 metres long in the open country, far removed from other telegraph wires, I ascertained that a quick succession of crackling noises could be heard in the telephone, recurring at intervals of greater or less duration. I quote from what I said in my note of August, 1878:—'If one listened a moment at the telephone the silence was perfect, only from time to time a quick succession of sharp crackling noises were heard, which suddenly ceased after a more or less sharp snap. . . . . The phenomenon varied according to the hour of the day, the state of the sky, the hygrometric condition of the air, &c. . . . . When the barometer fell, and the atmosphere, although without clouds, was thundery throughout the day, then the intensity and frequency of the noises were nearly uniform. . . . During a thunderstorm these noises occurred in quick succession and very loud immediately prior to a flash of lightning.' I thought at first that they were due to successive discharges of the conductor, after it had been saturated to a certain degree with electricity from the atmosphere. I put aside earth currents as being the cause, since they are nearly continuous, and their variations are not of sufficient rapidity to produce the peculiar noises heard in the telephone. These currents were induced currents, and I assured myself of this in the following manner:—From the top of a terrace situated on the top of my house I stretched a galvanised wire of 2mm. diameter and about 130m. long, each end of the wire being in connection with gas pipes. I placed in circuit a pair of telephones, and thus, when a thunderstorm approached or passed at the horizon, I was enabled to ascertain that each lightning flash, even the farthest off, corresponded to crackling noises, followed immediately by a characteristic snapping noise. By the aid of two small microphones, arranged on the diaphragm of the telephone receiver, I heard the least noise at a distance of one metre and over from the second telephone. I make use of this arrangement at the present moment, the apparatus being set up in a quiet room, on a table whose legs rest on discs of lead or gutta percha, to eliminate foreign sounds. I have heard the peculiar noises described not only during thunderstorms, near or distant, but also, although more rarely and with far less intensity, in winter, and sometimes even on fine and almost cloudless days."

WEST INDIA AND PANAMA TELEGRAPH COMPANY.—The report of this Company states that the amount of credit of revenue for the six months ending June 30 last is £41,303 4s. 1d. The expenses amounted to £29,366 12s. 8d., leaving £11,936 11s. 5d., which, with £1,956 5s. 9d. brought in from the previous account, makes a total of £13,892 17s. 2d. Out of this it is proposed to pay 3s. per share on account of arrears of Preference interest—£5,184 9s.—and to carry forward the balance. Negotiations with the colonial Governments for an increase of the subsidies are being continued.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All communications to be addressed to 396, Strand, London, W.C.

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THE LATE STORM.

The terrific gales which have swept, or rather belaboured, these islands with more or less fury during the present month have once again aroused public attention to the precarious condition of our system of telegraphic communication. To give point to the newspaper complaints there reaches us simultaneously full particulars of the German system now almost entirely completed underground, together with the humiliating intelligence that little or no interruption to traffic has been experienced in that country by a disastrous visitation which has crippled and isolated most other countries. Only upon the lines communicating with Bavaria was there serious interruption, and those were the sole remaining links of overhead telegraph left standing in the German Empire. With us, on the contrary, an underground system, except in towns, and there only for the wires belonging to the State, is a rarity, our entire dependence being placed upon timber and ærial festoons. Fortunately we are seldom overwhelmed with such a hurricane as that we are just now recovering from; but if it is not wind it may be snow, and what either or both of these may spare, time and the natural process of decay will strike. The integrity of our system is maintained by one continuous labour of restoration or renewal. This is going on always and at all places, absolutely new lines being alone exempt from the necessity of constant repair. Not a year ago we had one lesson of what winter can do in the way of destruction; now the autumn has taught us another. It is high time we profited by these warnings, and this message from Germany has opportunely come to enforce them.

The magnitude of the work which has been carried out by Dr. Stevan, the Postmaster-General of Germany, may be estimated from the particulars given in our last issue. The operations of substituting underground cables for the overhead lines were begun in March, 1876, and last June saw them virtually completed by the laying of the cable between Cologne and Aix-la-Chapelle. Cables to the extent of 3,394 miles, containing on an average seven wires each, have thus been laid in the short space of five years. As was pointed out in these columns not long ago, Germany has political or military reasons for a work of this kind that are, perhaps, not so urgent with us. But in the sense of security and the stability thus given to her domestic and commercial intercourse she will have her reward. She cannot command a similar assurance with her international relations; but in this respect, at least, Germany is a Free-trader, doing the right thing for herself whatever other people may do; being, perhaps, also peculiarly fortunate in this that the blessings of her liberal policy will not light upon the wrong shoulders.

The extent of the damage annually done to us who have not yet earned this immunity from the vicissitudes of tempest and war cannot easily be ascertained; but we may safely conjecture that it is something very considerable. The loss of traffic by reason of a general breakdown must represent a large sum of money, and the cost of repairs would constitute an ugly item on the wrong side of the accounts if the telegraph were the property of a public company. As it is, there will be the usual compliments in the Postmaster-General's report assuring us that the work of restoration reflected the highest credit on everybody concerned, and there the matter will end. At least there, we fear, it will end; for rumours are again afloat that a reduction of the tariff is contemplated, and a sixpenny rate is a more showy reform than a safe telegraph. That we should be allowed to send cartloads of messages slowly and uncertainly at sixpence may be well, though we are by no means satisfied about it; but it would be better still if we first made sure of sending them at all times, in all weathers, and at all speed. This is what a telegraph is good for if it is good for anything. The price is not of first consequence; rapidity and certainty are. Telegrams of the post-card type were best consigned to the halfpenny post. To encourage that kind of traffic is like hooking your goods train on to the express — it delays everybody and benefits nobody. There is, of course, an advantage in having a very low tariff, the advantage, namely, of paying, say, sixpence for what now costs a shilling; but this is all. The talk about extending the blessings of cheap telegraphy to the multitude is mere claptrap, and certain we are that cheap telegraphy for the multitude who seldom really need it will be the reverse of a blessing to the people who put it to its legitimate uses, so long as our telegraph system remains what it is. When it has been placed on a perfectly safe and permanent footing, some trustworthy estimate could be formed of the traffic it is capable of carrying constantly, punctually, and well. If the German system of underground cables prove that a more popular element is admissible, rates will be cautiously reduced; if not, the

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popular element will remain where it is. It is greatly to be desired, though hardly to be expected, that the controllers of the telegraph in this country will take the same practical view of their duty. If we have one ray of hope it is from the fact that these are the days of disestablishment. Possibly the Postmaster-General, imitating his illustrious chief, may turn his attention to telegraph poles. They have been proclaimed often enough; the resources of civilisation will not be exhausted until they are disestablished and cut down.

PARIS EXHIBITION.

Awards in British Section.

Grand Diplôme d'Honneur.

Post Office.

Diplôme d'Honneur.

Society of Telegraph Engineers.
Telegraph Construction Company.
Eastern Telegraph Company.
Submarine Telegraph Company.
Professor Hughes, F.R.S.
Sir W. Thomson, F.R.S.
Messrs. Siemens Brothers.

Lettres de Co-opération.

Royal Institution.
King's College.

Gold Medals.

Anglo-American Brush Company.
British Electric Light Company.
Messrs. R. E. Crompton and Co.
India Rubber, Gutta Percha Company.
Messrs. Clark, Muirhead, and Co.
Mr. Edward Bright.
Elliott Brothers.
Mr. Swan.

Silver Medals.

Mr. Apps.
Profs. Ayrton and Perry.
Mr. Brotherhood.
Consolidated Telephone Company.
Exchange Telegraph Company.
Mr. Fyfe.
Messrs. Johnson and Nephews.
Mr. Robey.
Mr. Sabine.
Messrs. Saxby and Farmer.
Mr. Spagnoletti.
Messrs. Thomson and Sterne.

Bronze Medals.

Messrs. Blakey and Emmott.
Mr. Bourne.
Mr. Coxeter.
Mr. Foxcroft.
Mr. Hedges.
Mr. O'Lawler.
Mr. Patterson.
Mr. Ransome.
Mr. Sabel.
Mr. Sax.
Mr. Smith.
Messrs. Stiff and Sons.
The Dowson Gas Company.
Messrs. Wallis and Steevens.
Whitecross Wire Company.

Electrical Steering Apparatus.—It is stated that the French Minister of Marine will be present at the end of this month at some experiments which will be tried with a new electrical steering apparatus. The name of the inventor and his origin are not, however, mentioned.

THE ELECTRICAL EXHIBITION AT PARIS.

Electric Lighting.

Mr. Swan's Lamps.

The effective manner in which Mr. Edison's rooms are lighted is equalled by the manner in which Mr. Edmunds, the representative of Mr. Swan, has lighted the rooms in his charge. The gathering together of these incandescent lights at Paris recalls to our mind the lines in "Sigurd the Volsung:"—

But, lo! at the last a glimmer, and a light from the West there came.
And another and another, like points of far-off flame;
And they grew and brightened and gathered, and whiles together they ran
Like the moon-wake over the waters, and whiles they were scant and wan.

Resuming, however, our remarks in prose, the exhibit of Mr. Edison differs in some essentials from Mr. Swan's. The former has aimed at giving a system complete, a system that will compare favourably, and compete successfully, with gas. The latter has given us a lamp, excellent it may be, but still it forms but one important portion of a system. Mr. Edison has considered his lamps in his design of machine, and his machine in his design of lamps. He has also a method of mains and insulation, of compensating the varying resistances in the circuit, and of measuring the current used by a householder. It can hardly be expected, then, that lamps dependent on machines taken at random will be equally good at all points with those designed as part of a system, and yet we doubt if any observer would deliberately give an opinion as to the superiority of the one over the other. Considering the four systems mentioned in our last issue, we doubt if, putting on one side everything except the general impressions obtained by walking into the rooms lighted at Paris, the numbers preferring the respective lamps would not be about equal. But of course, sooner or later, the economy of the several lamps plays its part in their general adoption.

The Swan lamp is better known in England than any other form of lamp. It has been exhibited in many places on different occasions. It is installed in various private and public buildings, and also on board some of the magnificent vessels of what we may term our "passenger navy." It is to be found in use in some of our mines, the most recent installation being that at Risca Colliery, carried out by Mr. R. E. Crompton. The Savoy Theatre is partially lighted with these lamps, and they are to be introduced in the lighting of the Mansion House. The accompanying illustrations, for which we are indebted to our contemporary, *La Lumière Electrique*, show the Swan lamp as used under different conditions, (1) to light up the business premises of Mr. Swan at Newcastle-on-Tyne; and (2), to light one of the streets of that town.

Mr. Swan's lamp does not differ much in outward appearance from that of Mr. Edison, as will be seen by comparing the illustrations of the lamps. Mr. Swan (see Figure 3) encloses his carbon filament in an exhausted globe, the contacts being made by springs at the side of the stem into which the globe is fixed. We have said that Mr. Edison's filament is composed of carbonised bamboo. Mr. Swan's filament is obtained from cotton. A number of threads of cotton are taken, and, so to speak, parchmentised by being plunged into a mixture of one part of sulphuric acid to two parts of water. The bottom thread thus prepared is then carbonised. To obtain good cotton the ends of the threads are by a similar process thickened and fastened to platinum clips. It may, perhaps, be interesting to many to have a little more information about this method of treating vegetable fibres. More than twenty-five years ago Mr. W. E. Gaine made known his experiments in this direction; then the Rev. J. Barlow, F.R.S., delivered a lecture on the subject in 1857, at the Royal Institution; and in 1858 Professor Hoffman reported on the process to Messrs. De la Rue and Co. This report will be found in the *Journal of the Society of Arts* for Nov. 19, 1858. We quote from this report:—
"... In its appearance, vegetable parchment greatly resembles animal parchment; the same peculiar tint, the same degree of translucency, the same transition from the

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fibrous to the hornlike condition. Vegetable, like animal parchment, possesses a high degree of cohesion, bearing hygroscopic, acquiring by the absorption of water increased flexibility and toughness."

FIG. 1.

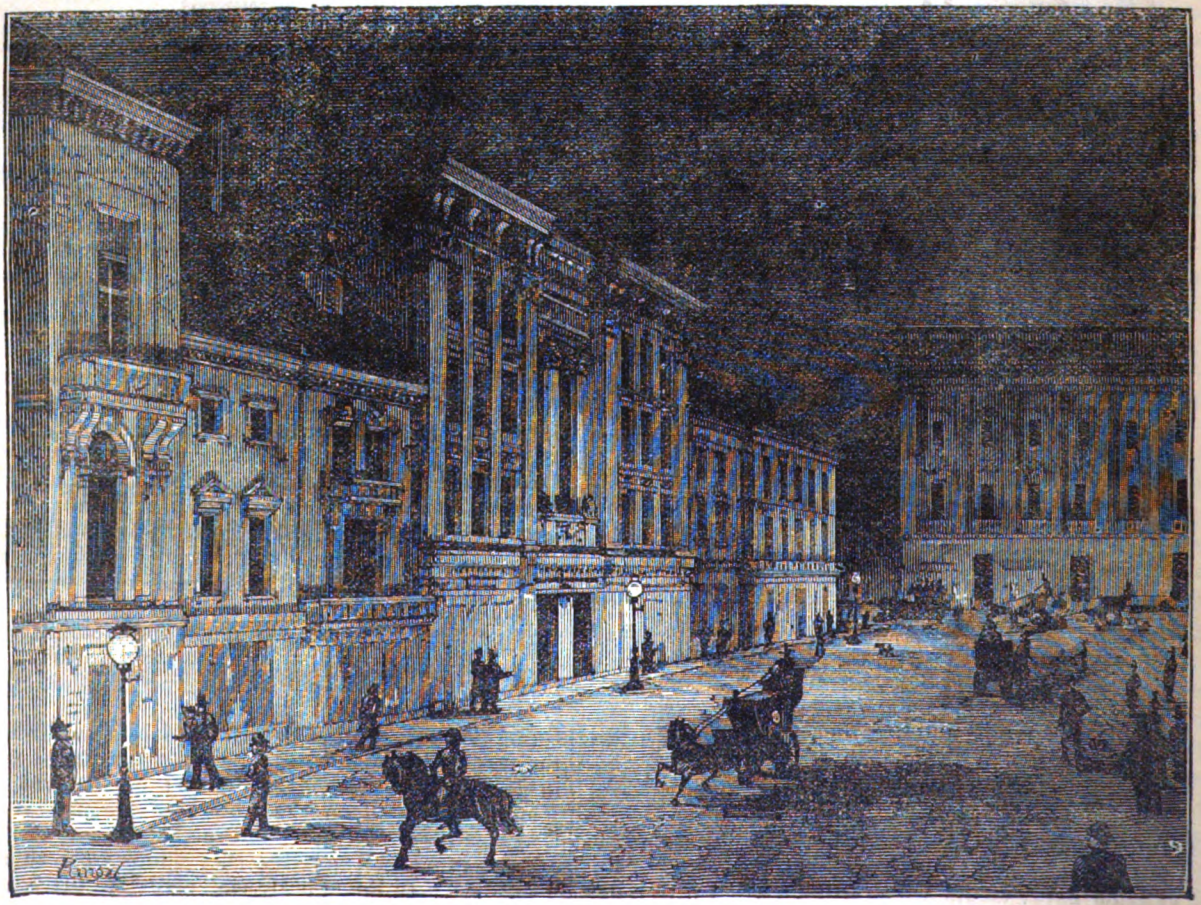

FIG. 2.

requently repeated bending and rebending, without showing any tendency to break in the folds; like the latter it is highly

It will be seen from this quotation that if some of the properties acquired by the paper during the process of parch-

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mentisation are retained after carbonisation, the material forms a valuable adjunct to the tools of electric light engineers. Now, experiment has proved that these useful properties are retained, and hence the success of Mr. Swan.

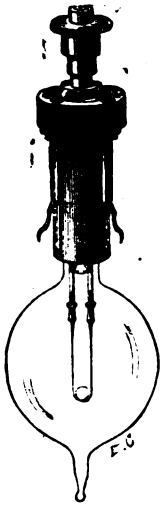

Fig. 3.

His filaments have "a high degree of cohesion," they will bear a considerable amount of handling, and so on. Mr. Edison has not overlooked this method of treating vegetable

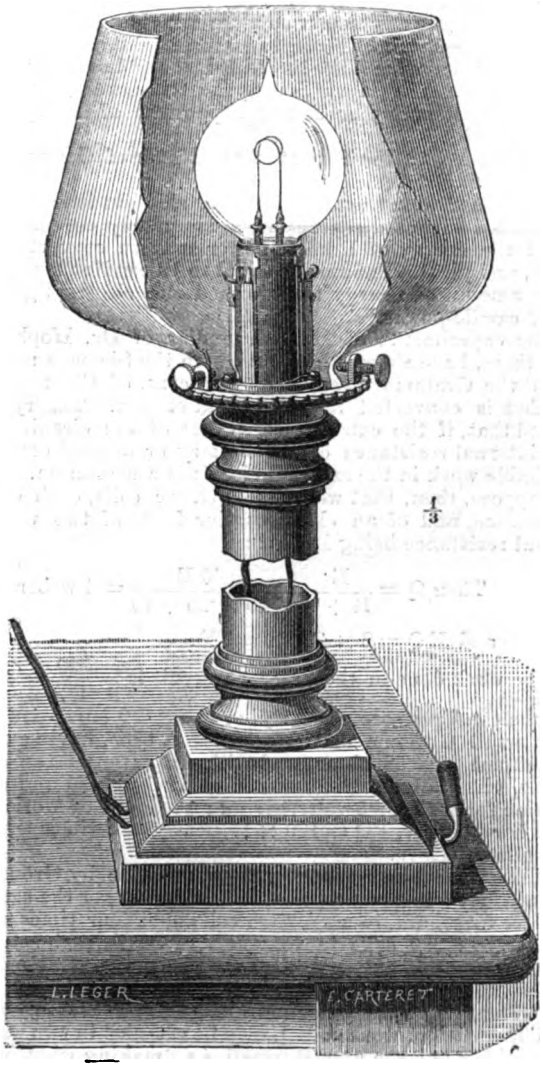

Fig 4.

fibres, and shows some filaments of bamboo which have undergone this process.

Another paragraph in Professor Hoffman's report says:—"In converting unsized paper into vegetable parchment by . . . immersion for a few seconds into oil of vitriol, dilute with half its volume of water, I was struck by the observation how narrow are the limits of dilution between which the experiment is attended with success. . . . . Altogether the transformation of ordinary paper into vegetable parchment is an operation of considerable delicacy, requiring a great deal of practice. . . ."

In a note appended to the report details of experiments to ascertain the strength of the material are given, showing

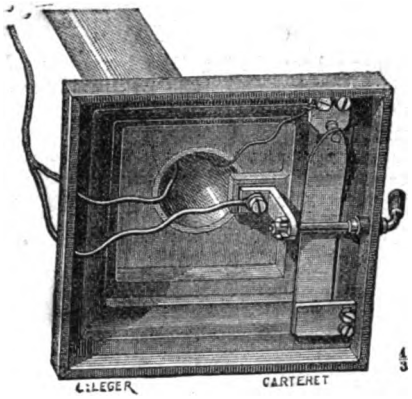

Fig. 5

vegetable parchment to have about three-fourths the strength of animal parchment. We think that great credit must be given to Mr. Gaine for the work which is proving so advantageous to incandescent electric lighting.

To return, however, to Mr. Swan's lamps. When the filament has been prepared it is raised to incandescence in order to expel the gases within its pores. This incandescent state is continued a considerable time, and the globe highly exhausted and hermetically sealed. In Fig. 4 the lamp is shown as

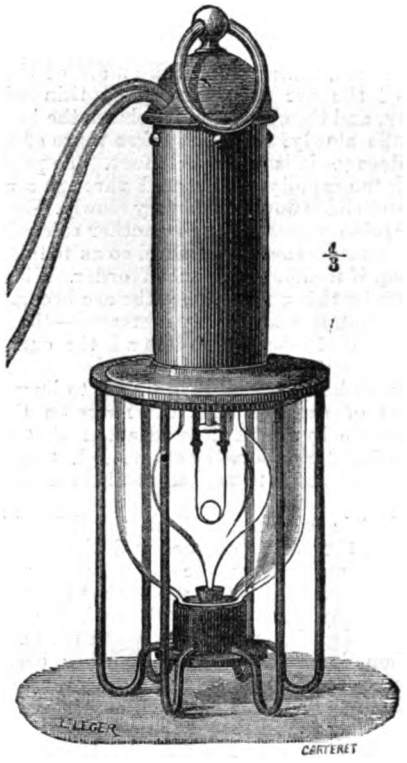

Fig. 6.

arranged to stand upon the table, the electrical connections being shown in Fig. 5. It will be seen that by merely turning the handle, shown to the right of the base of the lamp stand, contact is made or broken by means of a broad metal spring and a contact piece. The lamp designed for use in mines is shown in Fig. 6, and lamps of this kind may be seen both among Mr. Swan's exhibits and among Mr. Crompton's. We have now to deal with the Maxim and the Lane-Fox lamps.

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CANTOR LECTURES.*

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

BY PROFESSOR W. GRYLLS ADAMS, F.R.S.

LECTURE III.—DELIVERED MONDAY, MARCH 21, 1881.

(CONTINUED FROM PAGE 365.)

CROMPTON LAMP.

The carbons are brought together by means of the weight of the upper carbon holder, as in the Serrin lamps. The carbons are controlled by means of an electro-magnet, of which the principal armature separates the carbons, and a light secondary armature is arranged on the back of the large one, and does the more delicate work of bringing the carbons together. The large armature supports the negative or lower carbon; and when the small armature has brought the carbons together, so that a current passes, the large armature separates them to the proper distance apart for a good light. When the arc is broken the armature, supported by a spring, is raised, and brings the carbons into contact, and re-lights the lamp. The small variations in the strength of current re-act on the second armature, which is held at some distance above the large armature by a light spiral spring. The small armature carries an arm, which is applied as a brake to a brake wheel, which is the last wheel of a train of wheels, set in motion by the weight of the positive carbon rod.

REGULATOR FOR BRUSH SYSTEM.

A very pretty arrangement for shunting the current past a lamp (when it is not in use), so that one lamp may be put out without affecting the other lamps in the circuit, is adopted on the Brush system.

The current passes through a solenoid coil, wound with thick wire, and then passes to the upper carbon, through the arc to the lower carbon, and then by the frame to the next lamp. The solenoid holds up a rod of iron, which tilts a ring on one side, through which the carbon passes, and so locks it. To the end of a thick wire of the solenoid is attached a thin wire (150 ohms), which is also wound on the solenoid, and which forms a shunt or by-pass to the arc, taking more and more of the current as the resistance of the arc increases. This thin wire is wound the opposite way, and the current in it relaxes the hold on the carbon, so that it falls slowly, and then takes more of the current. As soon as it does so, it is again held fast. To prevent the carbon from falling too rapidly, it is passed through a vessel containing glycerine, and slides downwards very slowly. The current through the thin wire also passes through another solenoid, which forms a shunt or by-pass to the whole lamp, so as to take all the current past the lamp if it should get out of order. When a considerable current flows by this path—*i.e.*, if the arc becomes an inch long, so that its resistance is greatly increased—the second solenoid draws up a piece of iron, which lets all the current pass and the lamp is thrown out of the circuit.

In the Brush lamp, which is designed to burn 16 hours, there are two pairs of carbons, with the rings on the upper carbons, which hold them by friction, so adjusted that one is held about one-fourth of an inch above the other, and, therefore, the second carbon will not come into action until the first falls or is burnt out.

All the electric candles, such as the Jablochkoff candle, the Jamin candle, the Wilde candle, and the De Meritens candle, consisting of three carbons, are fed by means of alternate current machines, because it is essential that the two carbons should burn away equally. In the Jamin and the Wilde candle the carbons are at first in contact, but when the current passes, one of the carbons is separated from the other, because its holder is set on a hinge, so as to be acted upon by a small electro-magnet through which the current passes.

M. Joubert has found that it is necessary, in order to keep the arc steady with the Jablochkoff candle, that the alternate current in the circuit should have a mean value of eight or nine webers, and that below five webers the arc cannot be kept alight; between the bases of the two carbons forming the candle there is an electromotive force of 40 or 45 volts. The Jablochkoff candle uses up about 66 kilogrammetres of work, of which 33 kilogrammetres, or 4·6 h.-p., is converted into heat and light.

When the arc is produced in a magnetic field, either by disturbing it by an electro-magnet, or by placing a frame around it, as in the Jamin candle, it is necessary to have a current half as large again as when the electro-magnet is not in action. One-third of the energy of the current is in such a case spent in producing a strong magnetic field around the electric arc, and is, therefore, so much wasted energy, as far as the electric light is concerned.

* Reprinted from the *Journal* of the Society of Arts.

LECTURE IV.—DELIVERED MONDAY, MARCH 28, 1881.

Subdivisions of the electric current.—Incandescent lamps.—Luminous effects of electric currents in a vacuum, and in various gases.

When gas was first introduced extensively for lighting purposes many objections were raised to its use, and among them was one which was recorded by Clement Desormes, in 1819, which is summed up in the following quotation:—

"The light is of a disagreeable yellow colour, entirely different from that red and warm gleam of oil lamps; it is of a dazzling brightness; its distribution will be impossible and irregular, and it will be much dearer than oil lighting, and, even if it should be improved, it will still remain much dearer than those lights which we already possess."

Just as Desormes had become accustomed to the red gleam of oil lamps, and objected to the coldness of the yellow gaslight, so, a year or two ago, a similar objection was raised against the electric light, that it was entirely different from the yellow and warm gleam of gaslight; that it is of a dazzling brightness; that its distribution would be impossible and irregular; and that our streets would be left in darkness.

These objections do not seem to be so strongly taken up by the public as they were two years ago, for they have seen several trials of the electric light; and, although there are many difficulties in the way, yet the fact that the electric light has all the colours more uniformly blended, and is, therefore, a whiter light than gas, and enables objects to be seen in their true colours, can hardly be urged any longer as an argument against its use. The same argument might be urged for the same reason against bright moonlight, or against the light of day, and in favour of a yellow London fog. The Kyrle Society, in its search after truth and beauty, must surely be strong supporters of the spread of the electric light.

If we turn to the Report of the House of Commons, we find the following statement:—

"A remarkable feature of the electric light is that it produces a transformation of energy in a singularly complete manner. Thus the energy of 1 horse-power may be converted into gaslight, and yield a luminosity equal to 12 candle-power. But the same amount of energy transformed into electric light produces 1,600 candle-power."

The experiments of Mr. Schwendler, of Dr. Hopkinson, and of others, have shown that, both with the Siemens machine and with the Gramme machine, 88 per cent. of the total work expended is converted into electrical energy. Theory has established that, if the external resistance of the circuit is equal to the internal resistance of the battery or magneto-machine, the available work in the external circuit is a maximum.

Suppose, then, that we have 40 Grove cells, each of ·25 ohms resistance, and of an electromotive force of two volts, the external resistance being 10 ohms—

$$\text{Then } Q = \frac{E}{R + r} = \frac{40\,E}{40 \times \cdot 25 + 10} = 4 \text{ webers,}$$

$$\text{and } EQ = 2 \times 4 \times 40 = 320.$$

The work done in the external circuit is $\frac{320}{9{\cdot}81 \times 2} = 16$ kilogrammetres per second nearly, or about 2·9 horse-power.

A small Gramme machine of the A type, having an internal resistance of 4·58 ohms, and with an external resistance of 4 ohms, gives an electric current of 17·5 webers and an electromotive force of 158·5 volts, giving an amount of work equivalent to 2 horse-power, EQ = 160 × 17, nearly = 8 times the energy of 40 cells of Grove.

If we wished to replace such a machine by Grove cells, we should have to arrange about 80 cells to get the same electromotive force, and to make each cell about four times as large, or to arrange 320 cells in four sets of 80 in each set, to get the same amount of external work done as by the Gramme machine. This will show how impossible it is to do the work by voltaic batteries, which can be done by magneto-electric machines.

The equation, work = EQ, may be satisfied in two ways—either by making Q large and E small, *i.e.*, making what is called a quantity machine which will only do effective work when the external resistance is small; or we may make Q small and E large, *i.e.*, what is called a tension machine, which requires an external resistance large enough to prevent the machine from being overheated, and to satisfy the relation for the greatest amount of external effective work.

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COMPARISON OF TWO GRAMME MACHINES.

	Quantity.	Tension.
Number of turns per minute	797	967
Internal resistance	1·2	4·58
External resistance	1·14	4·00
Current in webers	29·67	17·51
Electromotive force in volts	81·58	158·50
Work spent to produce current	243	277

Thus we see that the total amount of energy is nearly the same in the two cases, but in one case it is spent in driving a large current through a small resistance, and in the other a smaller current is sent through nearly four times the resistance, and to do this a higher electromotive force is required. The higher electromotive force is obtained by increasing the number of turns of wire in the bobbin and in the magnet, so strengthening the magnetic field, and also by increasing the number of turns of the machine.

We arrive, then, at the conclusion that, to overcome higher resistances more effectively, higher electromotive force, and, therefore, higher speed is required. Now, our resistances may be so high that an ordinary current of electricity, even from a dynamo machine, will not pass through it, in which case we have to resort to another method of producing electricity, of still higher electromotive force, but the quantity produced is then considerably diminished. We have, then, to take an induction coil, consisting of two coils, in one of which in a current of electricity from a battery is passing, and by suddenly breaking and making this current, to obtain great changes of the magnetic field, and hence great electromotive forces, and so get very powerful alternating currents. We know the effect of checking suddenly the flow of water in a pipe. Sometimes the increase of pressure so produced may be sufficient to burst the pipe, and this is one transformation of the energy of motion of the water. This is analogous to the development of the energy of the induction current by the sudden checking of the electric current in the primary circuit. Water may be raised to a high level by a series of sudden impulses, as in the hydraulic ram. A flow of a considerable quantity of water being suddenly stopped, there is at once a sudden increase of pressure, which is sufficient to lift a valve, and allow a small quantity of water to pass into the reservoir or air-chamber. This air-chamber regulates the action of the flow of water up the pipe from the reservoir, just as the resistance and capacity of the secondary circuit regulate the secondary induction current when the primary current is broken. The action of the induction coil is very well illustrated by the action of the hydraulic ram, the level to which water is raised corresponding to the electromotive force of the secondary circuit. Just as in the hydraulic ram the quantity of water raised by the machine is at the best only about 66 per cent. of the quantity used, so in making use of the induction current to do work, or to produce the electric light, it is impossible to convert more than a fraction of the energy of the original current into useful work.

In the two systems of electric lighting to which I wish to draw special attention this evening, we have instances of the two opposite methods of accomplishing the same end—viz., the lighting of moderate-sized rooms by a steady and pleasant light.

THE WERDERMANN OR JOEL ELECTRIC LIGHT.

In the Werdermann system, or the Regnier system, a small thread or point of carbon abuts against a plate or edge of carbon or of copper, and becomes heated by the current so as to give out a glowing light, and gradually consumes away, but more and more slowly as the carbons are more and more improved. In these lamps, kindly lent to me by Mr. Latimer Clark, and in these Joel lamps, kindly lent to me by Mr. Joel, who has introduced several improvements into the original Werdermann lamp, the resistance of the contact of carbon is very small, about ·134 of an ohm, hence it will take several of them, 7 or 8 (or perhaps 10), arranged in series in the same circuit, to equal the resistance of the electric arc. To work these lamps of low resistance, only a low electromotive force is required, and so the result is attained by driving a small resistance dynamo-electric machine at moderately low speed; or by placing a considerable number of lamps in series, so as to make their combined resistance equal to or greater than the internal resistance of the machine. Thus a Gramme machine, revolving at the rate of 1,200 revolutions a minute, giving an electromotive force of about 130 volts, will give a current of 50 webers through about 10 lamps in series. But this current gives an illumination of 320 candles in each lamp, so that with this current we get an illumination of 3,200 candles in 10 lights. Now, the energy expended to produce this rate of revolution in a Gramme machine is about 9 or 10 horse-power. Hence the Werdermann, or the Joel lamp, gives at least two lights of 160 candles each for each horse-power of energy expended.

(TO BE CONTINUED.)

THE ELECTRIC LIGHT AND POWER GENERATOR COMPANY (LIMITED).

An extraordinary general meeting of the members of this Company was held at the Cannon-street Hotel on Wednesday, the 26th inst., Admiral Sir E. A. Inglefield, C.B., D.C.L., F.R.S., presiding.

The SECRETARY (Mr. F. H. Landon) having read the notice convening the meeting,

The CHAIRMAN said: Gentlemen—Although the powers which the Articles of Association confer upon the directors of the Electric Light and Power Generator Company are sufficient to enable us as a board to deal with the matter for which you have been called together, we have thought that it would be more courteous to you, and more satisfactory for ourselves to invite you formally to give your sanction to the proceeding of which you have received due notice. After long and mature consideration, and not until we had satisfied ourselves of the expediency of the measure, we have entered into a provisional contract for the purchase of a group of American patents, which include the now well-known Maxim incandescent lamp. It is this provisional contract we ask you this day to confirm. The negotiations which we carried on with the vendors extended over some months, and during that period every diligence was used by your directors, not only to assure themselves of the value of these inventions, but the best professional and legal advice was obtained towards ensuring the validity of the patents. The result has been that notwithstanding the delay we have largely profited in a pecuniary sense, for we have now provisionally concluded the contract on much more favourable terms than was at first contemplated. The price which has been accepted is £54,500, of which sum it will be open to us to pay £12,500 in shares. In this purchase are included all rights for India and our colonies with the exception of Canada. During the period of what by some has been thought a vexatious delay your directors have caused long and exhaustive experiments to be made with each form of lamp and dynamo machine for which they were in treaty, and this has resulted in confirming them as to the absolute necessity of now finally concluding the purchase. It must not, moreover, be supposed that in the meantime the business of the Company has been at a standstill—on the contrary. The American Company, with whom we were in communication for the purchase of the patents, have during the whole period of our negotiations supplied this Company with their dynamo machines and the different kinds of lamps manufactured by them. These have been applied by the Electric Light and Power Generator Company for carrying out various contracts which they had entered into, and occasionally, when thought advisable for the interests of the Company, machines and lamps have been utilised to exhibit our system of electric lighting in public buildings and on public occasions. These opportunities, although not affording an immediate remunerative return, have been highly beneficial as advertisements, and your directors are able to trace to these occasions several of the applications, and some of the orders given to the Company to supply their apparatus, and this especially with reference to orders now being completed for one of Her Majesty's largest and newest ironclad ships. Patents for the Indian Empire and several of the most important of the British Colonies are now secured, and your directors are in actual treaty with reference to granting concessions both abroad and at home. These, it will be readily understood, when completed, will tend to relieve the company of much responsibility, and at the same time result, without any doubt, in an immediate large and ready money profit. I have now to move the following formal resolution, viz.:—"To confirm the agreement, dated the 8th day of October, 1881, and made between Marcellus Hartley, of New York, in the United States of America, of the one part, and the Electric Light and Power Generator Company (Limited), of the other part, being an agreement for the purchase, by the company, of the Maxim, Nicholls, and Weston patents, upon the terms therein mentioned."

Mr. MALCOLM LOW, J.P., a director, in seconding the motion, observed that the things they proposed to buy were mainly the Weston series of patents, consisting of dynamo machines and arc lamps, mainly suitable for lighting streets and large buildings, and the Maxim series of patents, consisting of dynamo machines, regulators, and lamps for the incandescent system of lighting. As regards the former, there had been practical success on a large scale in New York and other American cities, it had obtained a silver medal at the Paris Exposition, and the lights were to be seen in action (where their quality could be judged of) at Messrs. Maples' establishment, at Aldersgate Station on the Metropolitan Railway, all along Queen Victoria-street, and at other places. As regards the latter, there had been great and brilliant success in certain large American cities, and a gold medal had been awarded at the Paris Exposition. Here, in London, they might have been seen, and their brilliancy and beauty examined at the late Exhibition in Euston-road, and at Warwick House, and they might now be seen at M. Faure's exhibition at Charing-cross, and at the Company's factory at Bankside. After calling attention to various facts showing the superiority of the Maxim light, he referred to the price asked for the patents which had been mentioned by the chairman. He said that the directors felt that an extraordinary bargain had been made. Having alluded to, and recognised the great services of Mr. G. P. Harding, one of the largest shareholders, in behalf of the Company, he referred to the exclusive privileges which the patents gave to the Company, and stating that the terms also secured their sharing in all advantages of prospective inventions which might be made by the vendors within a certain term of years. Among those at present unfulfilled designs he might, perhaps, without violating any confidence, mention a secondary battery which they hoped might at least equal M. Faure's. Arrangements had been made for securing supplies of all plant, including the Maxim lamps themselves from America, as well as other arrangements, while skilled workmen would be sent to them, who would very soon put them in the posi-

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tion of being able to manufacture these lamps to a practically unlimited extent themselves. A political authority of some note had advised mankind generally in the words, "Never prophesy unless you know;" but in regard to the success of the Maxim system of incandescent lighting it was just because they did know that they ventured to prophesy.

Mr. WILLIAM ABBOTT stated that he had had considerable negotiations in connection with companies with which he had been associated with municipal bodies, and he had always found that the engineers and the lower stratum of the organisation of municipal bodies were the most difficult people to deal with. He knew from this experience that it was absolutely essential that this and all other electric light companies should have associated with them as part of their system the means, not only of lighting public buildings, but also private houses. The terms of the purchase of these patents had been considerably modified, for he believed that the price originally asked was £120,000. He thought that they were now beyond the experimental stage of the electric light, and he, therefore, thought that further expenditure on experiments should cease. With regard to the question of competition he thought it would be mutually advantageous to the companies who were in existence to combine, as had been done in the telephone companies, and arrange a fixed price, an arrangement similar to the pooling of railway rates in America. London was large enough to absorb all the work that the existing companies could do for years. There were then Liverpool, Glasgow, and other important places, and he held that it was absurd for a board, having charge of their shareholders' capital, to go on competing for the sake of business.

Mr. BLADES asked the distinctive difference between the Maxim and the Swan incandescent light.

Mr. MONRO said that any one who had seen the Maxim light would admit its superiority. They had also heard from Mr. Low what he (the speaker) was not previously aware of—that it had been adopted for the stage and footlights of the Opera House at Paris. He then read an extract from *Le XIX. Siècle* of the 20th inst., in which the writer referred to his visit on the previous night to the Paris Opera House. The writer, who described himself as completely disinterested, being a shareholder in neither one company nor the other, concluded as follows:—"*En resumé* we shall be much astonished if the results actually given do not bring the following consequences: The Jablochkoff lamps will be retained in the loggia—that is to say, they will be placed on the Place de l'Opera; the lighting of the grand staircase by the Brush lamp will be abandoned; and for the lighting of the public saloon, the two small saloons at its extremity, the grand chandelier of the auditorium, the foot lights, side lights, &c., one of the incandescent lights tried yesterday, that of Maxim, will be adopted without a doubt. In this manner we shall have a light, soft, steady, warm, golden, giving no heat, showing off with advantage the dresses and faces of the ladies, avoiding also many chances of fire which at the present time, with some forty theatres burnt in one year, is not a point to be disdained." The forty theatres, he (Mr. Monro) supposed, were taken, little and big, all over the world. He thought that what the writer had said was extremely valuable.

Mr. GRIFFITH stated that he had had an opportunity of examining the light at the Company's factory, and he acknowledged the courtesy of the Secretary on the occasion referred to; but he could not help noticing that they had more machines than they could actually use. The Maxim light might be as a light all that could be desired, but unless it returned them a good dividend, would it be advisable to sanction the agreement?

Mr. STRETTON referred to the occasional flickering and extinguishment of the Company's lights in Queen Victoria-street, and asked if the directors saw their way to remedy these faults.

The CHAIRMAN, in reply, agreed with a previous speaker that new machines would be coming forward in connection with the electric light, but he was quite sure that the shareholders would not ask the directors to stand still on that account. They had a number of Serrin-Lontin lamps, which were most successful for certain purposes, especially for indoor work. They had now obtained a lamp which they thought so much of that they might, perhaps, call it the Company's lamp, which would burn for sixteen hours without being touched. Every light in the City, not merely those of this Company, occasionally flickered, and that was the great difficulty which all the companies had to overcome. He thought that this Company by their experiments had now arrived at a lamp as near perfection as it could be. As to the question of competing with the other companies, they had made at an early period overtures to the other companies, so that they might learn actually what they charged, and this Company made the tariff of other companies their own. There were, however, certain things which this Company supplied different to that of other companies, and for which they must have their own price. They would not lose sight of the advantage of the establishment of a general charge; and he might mention that there were certain negotiations going on which they hoped might eventually be of the character to which he had alluded. As to the distinctive feature of the Maxim over any other lights, they avoided mentioning any names, but they said that what the Maxim lamp claimed over all other lights was this—greater stability with regard to the length of time it would burn; the easy manner in which it could be carried about without the chance of breaking; and more than all it might be worked up to a candle-power of between 700 and 800 candles, while other systems could only be worked up about 40 without the lamp being destroyed or irretrievably damaged. Indeed, it was at one time thought of using it for street-lighting instead of the arc lamp. As to the forthcoming Exhibition at the Crystal Palace two of the members of the board had been asked to take seats at the council, and a space had been allotted to the Company for the exhibition of their systems. They did not exhibit at all in Paris, though the Maxim patents and principles were exhibited. The Lontin system obtained a gold medal at the Paris Exhibition.

Mr. ABBOTT observed that that showed the value of the Company's present patents; and he wished to disabuse one of the speakers of the idea he had that the acquisition of another patent would lead to their discarding their existing Lontin lamp.

The CHAIRMAN reminded the meeting that he had referred to the patents it was proposed to acquire as a group of American patents. They would all be of value in different ways. They had a very reasonable hope of making large profits by the concessions they would be able to sell in Great Britain, India, and our colonies.

Professor CROOKES said he had been asked to state some of the differences of the Maxim—he hoped he should soon be able to say their own—light. The principal difference between the Maxim process of incandescent lighting and others was in the preparation of the carbon filament—in fact that was the only difference. A patent could not be taken for anything else. In the preparation of the carbon filament there were very great difficulties which had been overcome by only three or four persons, although thousands had worked at them, and their success had been protected by patents. If a light of ten or twelve candles was required, a very good light could be obtained by means of any of the systems; but that power of light was yellowish. Up to twenty-five candle-power the lights of the different systems were about equal. If they went much beyond that the carbon filament being lighter and thinner and more delicate in the other systems than that of the Company the carbon filament began to break down, and the lamp got destroyed. He thought all the other systems would break down at the time that a light of about seventy or eighty candle-power was reached, and that the Company's system, the Maxim, would be the only one burning. It would then give a light far stronger than would be wanted, but it could be easily diffused—they could have 200, 300, 500, and 1,000 candle-power, and in one experiment he assisted at in Paris recently he saw the light go to 1,500 candle-power. This was equal to a very powerful arc light, better than they saw publicly exhibited in London. He wished to say that he had not the honour of being a director of the Company—he was simply the electrical adviser of the Company; but perhaps in that capacity he could be of more use to the Company than if he were on the board, for he was very well acquainted with the other companies and those in authority in connection with the other systems of lighting. He thought they would very likely be able to bring forward some friendly co-operation between this and the other companies. He could confirm in every particular what had been said in the extract read from *Le XIX. Siècle*. Only on the previous day he had arrived from Paris, where he had been acting as a juror in the Electrical Exhibition. In answer to a shareholder, he referred to the award of a gold medal to the Lontin system, and stated that that machine gave what was called an alternating current, which was not so economical for street lighting as a direct current. The Company would find the Lontin light invaluable to them in connection with the Maxim lamp. Replying to further questions, he said that they could easily, and at a profit, compete with gas, and charge the same price as was charged for gas, if they could light up a whole district as a gas company did. A secondary battery was almost necessary for the incandescent light in private houses, but they must have wires. The Professor also spoke of the greater facility as contrasted with gas with which everything in connection with the electric light could be fitted up in a private house.

The CHAIRMAN referred to the official communication of the Lords of Council on Education, who stated that in a period of nine months in which the electric light had been used at South Kensington, the cost had been £320, which was 42 per cent. less than the cost for gas in a similar period. He thought that that disposed of the question of cheapness, and it was to be borne in mind that that was the result of the lighting of only one building. This was the youngest company, and it was their object to make themselves perfect before lighting any district by contract in a regular manner. He then put the motion, and it was carried unanimously. He afterwards announced that an opportunity would be afforded that afternoon of witnessing the Maxim light in operation at their factory in Bankside.

Sir HERBERT SANDFORD, in reply to a question, stated that if the calls were paid as they became due they would not require to issue fresh capital, and additional further precautions had been taken (which he mentioned) to obtain the capital required for the purchase of the patents referred to without the issue of fresh capital.

Mr. G. P. HARDING, in reply to an invitation to address a few words to the shareholders, briefly confirmed all the good news which had been already given to them, and expressed his perfect satisfaction in all that had been done. He alluded to the enormous opening for electricity, stating that, judging from what had been seen in Paris, its application might be looked to for tramways, omnibuses, and railways, besides the lighting of towns, ships, factories, and so forth, in fact, in a hundred different ways. He concluded by moving a vote of thanks to the Chairman and Directors.

Mr. ABBOTT seconded the motion, and it was carried unanimously.

The CHAIRMAN replied, and assured them that nothing would be wanting on the part of the directors to promote the welfare of the Company.

The meeting then separated.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Oct. 26.		Business Done Week Ending Oct. 26. Highest.		Lowest.	
Anglo-American	51¼,	52¼	.....	52¼	.....	52¼
Do. Preferred	80,	81	.....	81¼	.....	81
Do. Deferred	23,	¼	.....	23¼	.....	23⅜
Brazil Submarine	11¼,	⅜	.....	11¼	.....	11¼
Cuba	9½,	10	.....	—	.....	—
Do. Preference	16,	17	.....	—	.....	—
Direct Spanish	5,	¼	.....	5¼	.....	5
Do. Preference	14¼,	15¼	.....	—	.....	—
Direct United States Cable	10¼,	⅜	.....	10¼	.....	10⅜
Eastern Telegraph	10,	¼	.....	10¼	.....	10⅛
Do. 6 per Cent. Preference	13,	½	.....	13¼	.....	13
Do. 5 per Cent. Debentures, 1899	105,	108	.....	—	.....	—
Eastern Extension	11,	¼	.....	11¼	.....	11⅛
German Union	10¼,	⅜	.....	10¼	.....	10⅜
Globe Telegraph and Trust Company	6¼,	⅜	.....	6 11-16	.....	6½
Do. Preference	12⅝,	⅜	.....	12⅝	.....	12⅝
Great Northern	11½,	12½	.....	—	.....	—
Indo-European	28,	29	.....	28½	.....	28½
Mediterranean Extension	2¼,	3	.....	2⅜	.....	2⅜
Do. Preference	9½,	10	.....	9⅜	.....	9⅜
Reuter's	11¼,	12½	.....	11¼	.....	11⅜
Submarine	290,	300	.....	297	.....	295
West India and Panama	1⅞,	2	.....	1 15-16	.....	1⅞
Do. 1st Preference	7½,	⅝	.....	7⅝	.....	7⅝
Western Brazilian	6⅝,	7¼	.....	7⅜	.....	7
West. Union 7 per Cent. 1st Mortgage	125,	130	.....	—	.....	—
Do. 6 per Cent. Sterling Bonds	104,	107	.....	106¼	.....	105½

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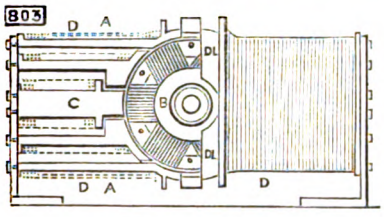
RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

803. IMPROVEMENTS IN DYNAMIC APPARATUS AND MOTORS IN BATTERIES AND IN CARBONS, &c., *R. Waller.—25th February*, 1881. 10*d*.

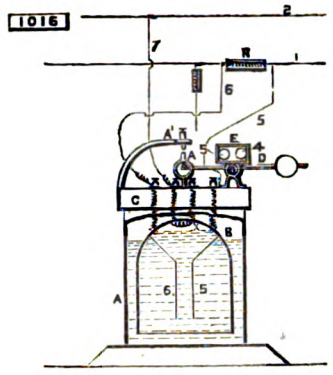
The inventor's improvement in batteries consists in giving a rotary or other motion to plates, cylinders, or other forms, whether compositions or otherwise, of materials and metals used in the production of currents. His improvements in dynamo machines are various; we describe one of them below. The figure shows a dynamic electro machine, with one armature composed of two hollow and one solid magnets on each side of the armature. The outer magnet A is covered with wire; the coils D D nearly cover the half, and if the side in section were covered there would only



be the poles D L uncovered with wire. The armature B is in six sections. Each section is a separate magnet. The core on which the wire is coiled can be hollow so as to receive pieces of turnings, cast or wrought iron, or pieces of wire. Two checks are fixed and joined to the wood which forms in smaller machines the insulator, and in which grooves are cut to receive the copper connections which unite the wires of the coils of the armature and the commutator. The armature thus works nearly all covered by the outer field magnet. Various modifications of this machine are also described.

1016. IMPROVEMENTS IN WEBER-METERS OR DEVICES FOR MEASURING AND REGISTERING THE CURRENT FLOWING THROUGH CONDUCTORS, *E. G. Brewer.—9th March*, 1881.—(*A communication from T. A. Edison.*) 6*d*.

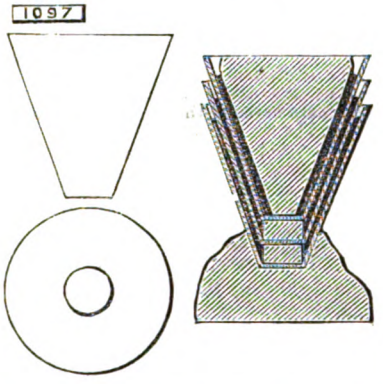
One part of this invention describes a meter, actuated by gases evolved by decomposing water with a definite part of the current. The figure shows a vessel of water, in which a second vessel floats. The current decomposing the water, the liberated gases rise into the second vessel, causing the vessel itself to rise in the same way as a gasometer rises. At a certain point of fulness a contact is made, the gases are recombined, and the vessel returns to its original position. Another method described is by means of the electro-deposition of copper. The electrode upon which the deposition is to be made is carefully balanced, and when a certain definite quantity has been deposited the electrode sinks down deeper into the containing vessel. This action reverses the current, and the copper deposited is now



taken off till the original condition is reached, when reversal again takes place, and so on.

1097. IMPROVEMENTS IN VOLTAIC BATTERIES, &c., *J. H. Johnson.—14th March*, 1881.—(*A communication from La Société Force et Lumière*, &c.). 6*d*.

The invention relates to the use of a series of deep vessels, narrow at the bottom and wide at the top, the vessels being filled with the exciting liquid, and arranged one within another so that their sides are brought into contact with the exciting liquid of the battery, both internally and externally. By this means a battery can be constructed in the form of a column, in which deep and taper vessels of a conical form are employed. In the case of batteries in which two liquids are used, porous partitions may be employed having



a form similar to the quasi-prismatic vessels employed in the Regnier system, their shape being modified, in order to obtain the requisite taper form. The porous partitions may be made from discs of felt pressed out in the form of bags, such as are used for filtering purposes, and combined so as to form cells of the required form and capacity. Both methods of construction are shown in the figure herewith. This invention applies as well to secondary batteries as to ordinary ones.

1119. IMPROVEMENTS IN TELEGRAPHY, *S. Pitt.—15th March*, 1881.—(*A communication from Dr. O. Lugo.*) 10*d*.

The first part of the invention relates to the conductors of an electric or telephonic circuit, and to a method of organising them whereby inductive action is prevented. The invention is based upon the discovery that if one portion of a circuit be surrounded by the other helically, one portion passing through the mathematical axis of the other, and being properly insulated therefrom, thus forming a solenoid, and either portion be used for the direct, and the other portion for the return conductor of a circuit, induced currents will be entirely prevented. Figs. 1 to 4 will give a better idea of the principle of this invention than we could give in words. Fig. 1 represents the two portions of a circuit organised in accordance with the principles of the invention. Fig. 2 is a modification of the same, more suitable for practical use. Fig. 3 is a theoretical diagram illustrating the application of the invention to a telegraph circuit.

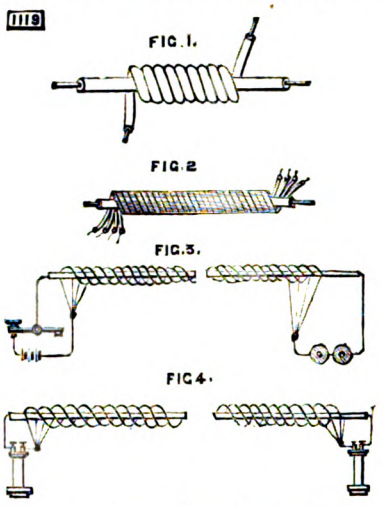


Fig. 4 the same for a telephonic circuit. It will be seen on reference to Fig. 1 that the length of the helical conductor necessarily exceeds that of the other; consequently, where of equal conductivity per unit of length, the total resistance of the one is greater than that of the other, although even in this case inductive effects would be prevented; still, it is better to have the two conductors of equal resistance. This is done by constructing the overlapping conductor, as shown in Fig. 2, of a compound helix consisting of several parallel conductors, which are of such thickness and conductivity as to render their joint resistance approximately the same as that of the direct conductor. The conductors being insulated from one another can, by being enclosed in iron pipes, be easily adapted for subterranean uses. The second part of the invention refers to their use for the transmission of both voltaic and magneto currents, with a portion of the apparatus at each station constituting a part of the direct conductor, and other portions constituting parts of the helical conductor.

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ELECTRICAL AND TELEPHONIC APPARATUS

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W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electricians and Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
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NEWTON'S PATENT LAW and PRACTICE, Price 2s. 6d.
This standard work contains all legal and other information necessary for intending patentees, including Government charges, agency fees, and rules of the Commissioners of Patents.
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DUNCAN WALLET & CO.,
BONDED STORE AND PROVISION MERCHANTS,
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Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

INSULATED COPPER WIRE, Silk, Cotton, or India rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

JOHNSON'S PATENT TRANSMITTER,
IN COMBINATION WITH
BELL'S EBONITE TELEPHONE.

Unequalled for Telephone Exchange or Private purposes.

ALL ROYALTIES PAID.

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ELECTRIC AND TELEPHONIC ENGINEERS,
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ELECTRIC LIGHT.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

HARBOROW & CO.,
ELECTRIC LIGHT ENGINEERS
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TELEGRAPH INSTRUMENT MANUFACTURERS,
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ESTABLISHED 1851.

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Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

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A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

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FRANCIS RAVENSCROFT, Manager.

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Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

SOLE PATENTEES OF UNTWISTED WIRE ROPE.

Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c.

Gilt and Silver Cord for Hanging Pictures. Iron, Steel, and Copper Cord for Clock and Sash Lines, &c.

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SLIP

SS. "Faraday."—We notice that this cable ship returned to Gravesend from the Atlantic on the 1st November.

Electric Light in Bristol.—Mr. John Lysaght, of St. Phillips, Bristol, has lighted up his galvanising works by means of the Brush system.

Electric Light at Rotherham.—It is proposed to adopt the electric light for the Bessemer Steel Works at Ickles, in the Rotherham district.

Telegraphs in Jamaica.—Thirty-one telegraph offices are now at work in the island, and during August 3,982 local messages were despatched by them.

Telegraphs in China. — A Reuter's telegram from Shanghai, says:—"A telegraph cable has been laid across the Yang-tze Kiang river to Kien Kiang."

Awards at Paris.—The name of Messrs. R. S. Newall and Company should be added to the list of those who received a silver medal at the Paris Exhibition.

Electric Lighting and Architecture.—The new volume of the *Transactions* of the Institute of Architects contains Mr. Slater's paper on "Electric Lighting."

Electric Light in America.—It is said that the electric light is to be introduced into the streets of Richmond, Va. Eight lights only will be used at first as an experiment.

The Telephone in India.—It is stated that the Government of India has at length granted a license to the Oriental Telephone Company to commence work in the city of Bombay.

The Late Colonel Glover.—Our contemporary, the *Journal Télégraphique*, devotes a portion of the space in its issue of the 25th October to a notice of the late Colonel Glover.

The Electric Light in Houses.—The Duke of Sutherland has decided upon lighting his residence at Trentham with electric lights. The British Electric Light Company have the work in hand.

West India and Panama Telegraph Company.—The estimated receipts of this Company for the half month ended the 31st October are £2,116, as compared with £1,182 in the corresponding period of 1880.

Festivities at Paris.—M. Berger, the Commissioner-General of the International Electrical Exhibition, gave a grand banquet on Monday last to the foreign commissioners and members of the congress.

"Colliery Explosions and Electricity."—This was the title of a paper by Mr. Thomas Canning, which was taken as read at a recent general meeting of the South Wales Institute of Engineers, held at Cardiff.

Electricity and Therapeutics.—According to *Le Monde de la Science*, &c., the first cure ever effected by means of electricity was in 1744, when Krazenstein of Halle cured a woman with a paralytic finger by this means.

Swan's Lamp in Middlesbrough.—The Swan incandescent lamp has been introduced into the Corporation Hotel, Middlesbrough. We believe it to be the first hotel in England that has adopted this light up to the present.

Communication in Railway Trains.—News from New South Wales says that the railway department has been testing the Winter's electric system of intercommunication between passengers and guards in railway trains.

Paris Exhibition.—Distinguished Visitors.—Amongst the visitors to the Electrical Exhibition last week were their Royal Highnesses the Prince and Princess of Wales, when they were both photographed by the electric light.

India Rubber, &c., Wanted.—The Uphall Oil Company require tenders for the supply for one year of chemicals, india rubber, gutta percha, &c. Forms of tender can be obtained of the manager, Uphall Oil Works, Scotland.

Electric Light in Regent Street.—Permission has been granted to the Anglo-Colonial Electric Light Company by the St. James's Vestry to light Regent-street, from the south side of Piccadilly circus to Pall Mall, at their own expense.

Electric Light in Spain.—According to the *Cronica Cientifica* of Barcelona, the Spanish Electrical Society have lighted up their offices with Swan lamps. From the same source it is reported as probable that these lamps will be used in the Royal Palaces at Madrid.

Cables Repaired and Interrupted.—As we stated last week, four of the Eastern Company's cables were broken by the recent gales; one of these was repaired a few days afterwards by the "Retriever," and both the "John Pender" and "Retriever" are now at work upon the others.

Western and Brazilian Telegraph Company.—The traffic receipts of this company for the weeks ending October 14th and 21st, 1881, were £2,066 and £1,946, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

Electric Light for Belfast.—Tenders are to be sent in to-day for lighting portions of the Belfast Harbour quays by electricity until the 1st of April next. The Harbour Commissioners are said to be very satisfied with the working of Mr. Crompton's lamps, which have been up for about two months now.

Crystal Palace Exhibition.—The entire exhibits of the Post Office, as now shown in Paris, will be transferred to the Crystal Palace after the close of the present Exhibition. We understand that several additions will be made to the apparatus, and that some of the modern instruments will be shown at work.

The Telephone in Belgium.—The Government is inviting tenders for working telephone lines in several of the large towns, including Brussels, Antwerp, Liége, &c. The tenders are to be sent in to the first and second class waiting rooms of the Bruxelles-Nord Station by 11 o'clock on the 16th November.

Electric Communication with Lighthouses.—The Lord Mayor, M.P., has received a letter from the Prime Minister acknowledging the receipt of a copy of resolutions passed by the meeting held at the Mansion House, and reported in our last issue, and stating that he has forwarded them to the Board of Trade.

Telegraphic Communication with India.—It is notified that communication with India by the Indo-European line is at present interrupted from this country, owing to the breakage of the submarine cable between England and Germany. The line is, however, working as usual in connection with the Continent of Europe.

Extension of Works.—Messrs. Phillips, Bros., of Homerton, are extending their premises, the work being carried on up to a late hour of the night by the aid of the electric light. The lamps used are, one of Mr. Crompton's large arc lights, and several Swan incandescent lamps. It is stated that the workmen are very much in favour of the light.

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CUBA SUBMARINE TELEGRAPH COMPANY.—The number of messages passing over the lines of this company during the month of October was 2,232, estimated to produce £2,300, against 2,022 messages, producing £2,102, in the corresponding month of last year. The traffic receipts for the month of August, estimated at £2,300, realised £2,401.

REDUCTION IN TELEGRAPH TARIFFS.—It is stated that the Government are endeavouring to reduce the rates for telegraphic communication between Victoria and Tasmania. They propose to reduce the charge on the land lines from 1s. to 6d. for ten words, and to contribute £600 towards a proposed additional subsidy to the Cable Company.

ACCIDENT CAUSED BY AN OVERHEAD WIRE.—At the inquest on a man who was recently killed in Birmingham by the fall of a chimney stack to which a wire was attached, the jury gave expression to an opinion that it was dangerous to the public safety to fix telegraph wires to chimney stacks, and that the only safe course was to carry them underground.

NEW TELEPHONE COMPANY.—A new company for working the telephone in most of the principal countries of Europe has been registered under the title of the "Edison-Gower-Bell Telephone Company of Europe (Limited)," with a capital of £500,000. It is stated that there will be no public issue of shares, the whole of the capital having been subscribed privately.

TELEGRAPHIC HISTORY.—At the meeting of the French Academy of Sciences held on the 17th of last month, it was stated that so far back as 1782 a system of telegraphy was described by Condorcet and de Milly to the Academy, by means of which signals could be transmitted to 30 leagues distance in a few seconds. No details of the system were given, however.

ELECTRICAL PATENTS.—We are informed that there is a complete set of specifications of patents relating to electricity and its applications in the library of the Society of Telegraph Engineers and of Electricians. All specifications of new patents also are received by the society as soon as published. In addition to which will be found the *Official Gazette* issued by the United States Patent Office.

ELECTRIC LIGHT IN SHEFFIELD.—The electric light in Messrs. C. Cammell and Co.'s works is said to be a great success. This is partly attributed to the motor, which is a Parsons patent engine, made by Kitson and Co., of Leeds, and works the dynamo-machine direct, without the intervention of belting, thus ensuring a good speed, combined with regularity. The lights are on the Brush system.

TELEGRAPH STORES WANTED.—The Cheshire Lines Committee are inviting tenders for the supply during the year 1882 of telegraph wire and materials, poles, &c. Patterns can be seen and forms of tender obtained of Mr. W. H. Legge, storekeeper, Central Station, Liverpool. Tenders must be sent by 12 noon on the 15th instant to Mr. Edward Ross, secretary to the committee, at the above station.

TIDAL POWER AT BRISTOL.—At a recent meeting of the Town Council of Bristol a motion was brought forward, but not adopted, that "instructions be given to the sanitary authority to cause inquiries to be made into the tidal power of the Avon with a view to its being utilised for working electric lights for the city, the storage of motive power and other purposes, and that scientific aid be employed for the purpose."

TELEGRAPHIC COMMUNICATION IN NEWFOUNDLAND.—It is stated that the fishermen are agitating for telegraphic communication round the coast of Newfoundland, as they say that frequently large catches of fish might have been made had the whereabouts of the "schools" been able to be telegraphed to the various fishing stations. The value of the telegraph to fishermen is evidenced in Norway, where the whole coast is in communication by this means.

SOCIETY OF ARTS.—The following papers, amongst others, are down for reading during the approaching session of this society, viz:—"Photometric Standards," by Harold Dixon; "Telephonic Communication," by Lieut.-Colonel C. F. Webber; "The Storage of Electricity," by Professor Sylvanus Thompson. A short course of Juvenile Lectures will be given during the Christmas Holidays, by Mr. W. H. Preece, F.R.S, on "Recent Wonders of Electricity."

NEW COMPANY.—The formation of the Compania Electrica de Cuba, with a capital of 150,000 dollars, and the right to increase to 500,000 dollars, is announced, with its headquarters in New York. It is stated that an exchange is being built as rapidly as possible, and that the company has now 150 subscribers. By a royal decree, issued from Madrid, the company has acquired the exclusive right to establish exchanges and operate the telephone in the Island of Cuba.

RETRIBUTION.—Some time ago Frank Griffin, the steward of the Eastern Telegraph Company's ss. "Retriever," then in the Levant, absconded with a considerable sum of money belonging to the ship. Owing to the description of him telegraphed to various places he was apprehended at the Cape of Good Hope and detained until the captain of the "Retriever" arrived out to prove the robbery. He was tried the other day, and sentenced to one year's hard labour on the Breakwater at Cape Town.

THE ELECTRIC LIGHT.—Mr. A. Jesseman, Professor of Natural Science at Dulwich College, gave one of a series of popular lectures the other day at the New Science and Art Centre, High-street, Marylebone. The subject was "Electricity and Light, and their relation to Magnetism and Heat." Several experiments were shown, and amongst other things a photometrical comparison between candles, oil, paraffin, gas, and the electric light was made, the result of which was much in favour of the latter.

PRICES.—The prices as quoted are:—For gutta percha, per lb., good to fine, 1s. 8d to 3s. 6d.; low to medium, 3d. to 1s. 7d. This is exactly one penny per lb. less than the prices ruling at same date last year. For India rubber, fine Para, 3s. 6d.; negrohead, 2s. to 2s. 2d.; central American, 1s. 9d. to 2s. 4d; Assam and Pegu, 8d. to 2s. 1d.; other East Indian, 1s. 3d. to 2s.; Madagascar and Mozambique, 1s. 9d. to 2s. 3½d. Fine Para and negrohead are both 3½d. per lb. higher, Madagascar 2d. higher, and all the rest about 1d. lower than the prices ruling last year.

THE ARC ELECTRIC WORKS AT CHELMSFORD.—A local paper says:—"These works promise to add materially to the prosperity of the town. Mr. Crompton, the proprietor, has already erected considerable premises for carrying on the business, and we understand that in consequence of the orders which are continually being received they will shortly be more than doubled in size. It is rumoured that four or five residents of Chelmsford have a scheme under consideration for experimental electric lighting in the town with the Crompton lamp, the object, we presume, being to induce the Board of Health to adopt the system."

PROPOSED INSTITUTION AT SILVERTOWN.—The India Rubber and Gutta Percha, &c., Company have combined with other employers of labour in the neighbourhood to form an institution at Silvertown, where popular instruction and

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amusement will be given to their *employés*. In connection with this institution lectures will be given on Monday, Tuesday, and Wednesday evenings on chemistry, electricity, magnetism, arithmetic, machine construction, &c. The first of these lectures was given recently by Mr. T. P. Bruce Warren "On the Claims of Chemistry as a Branch of Technical Education." We believe steps are to be taken at once to build a house for the institution. We congratulate the promoters on the step they have taken and wish all success to the "Silvertown Institution."

Electric Light at Chesterfield.—The trials of the Brush Electric Light at Chesterfield have been so successful that the Corporation have decided to dispense with gas entirely as far as public lighting is concerned, and to replace it by the electric light. The contract has now been secured by Messrs. Hammond and Co. for one year. The lighting will be done by means of about twenty-two Brush Arc Lights, and seventy Lane-Fox incandescent lamps. The annual cost is guaranteed by the contractors not to exceed the present gas bill. If the result proves it to be true that a better light can be obtained for the same price as gas, the example of Chesterfield is likely to be followed by other towns. In fact, we understand that deputations have already visited Chesterfield from Derby, Nottingham, Barnsley, Sheffield, and other towns, who are now in negotiation with the contractors for a trial of the Brush Light.

Electricity and Railway Signals.—A French paper says that the Southern of France Railway Company has attached to the locomotive a steam whistle which prevents a train passing a danger signal in a fog or snow storm by clearly notifying the engineer of the danger ahead. The whistle is connected with an insulated metallic brush placed beneath the locomotive, so that when the train passes the signals, the brush sweeps a copper-faced projecting bar placed between the rails. This bar is connected with the positive pole of a battery having its negative pole in communication with a commutator on the signal post, from which a wire leads to the ground. When the signal is "line clear" the passage of the brush over the fixed contact produces no result, but when the signal marks "danger" the commutator brings the negative pole of the battery in direct communication with the ground, and when the brush passes over the contact the completion of the electric circuit causes the whistle to be sounded and the engineer to be consequently warned.

Electricity and Fire Brigades. — A "Londoner" writes from Manchester as follows:—"Mr. J. S. Willis, the superintendent of the Salford Borough Fire Brigade, has invented an electric apparatus, and fitted it up at the Central Fire Station, which accomplished the following results under my own eyes. In the office to which the public or the police bring information of a fire having broken out, or to which it is telegraphed from the out-stations, is a small rectangular piece of wood fixed to the wall, and it bears a number of buttons like those attached to electric bells. Upon pressing one the great alarm bell at the top of the tower is rung, the gas is turned up in the engine-room and the stable, one of the engines is detached, and as the engine-room doors are simultaneously opened the engine glides out into the yard; the stable door is also thrown open. The other buttons cause the ringing of the bells in the bedrooms of some eighteen members of the brigade who live in the immediate neighbourhood. Of course there is a limited number of men always in attendance at the Central Station, and the result of the help afforded by Mr. Willis's ingenious and simple contrivance is that the engine and the men are ready to start for the fire, by night as well as by day, in thirty-eight seconds after the alarm has been received."

Electric Light Wires and Gas.—With reference to the note in our last issue under this heading, we reproduce the following letter to *The Times* from Mr. A. Angus Croll. In answer to that of the Gas Light and Coke Company to the Commissioners of Sewers, he says:—"Before charging the mains of the Great Central Gas Company for the first time—now more than thirty years ago—I placed the works and office in telegraphic communication. For that purpose a man went into one of the large mains from the works to the City, laying down the wires as he went along. This communication remained perfect some years, so long as the outer covering remained good, and, I need scarcely add, without any accident having taken place. Then, as now, it was suggested by an influential member of the Commission of Sewers that the laying down of the wire in the gas main would be attended with great danger to the City. Wiser counsel, however, prevailed, and I was not interfered with." Mr. J. Rand Capron, writing to the same paper, says:—"Any one may readily satisfy himself by direct experiment that there is not the slightest danger in placing electric wires within gas mains. In fact, coal gas not mixed with or exposed to air is uninflammable." Another correspondent explains that it is not the laying the wires in the mains themselves that is considered dangerous, but their being laid in subways containing mains, where it is possible for the gas to become mixed with the air, and consequently rendered explosive.

International Electrical Exhibition.—Awards.—*The Times* correspondent writes as follows:—"I have made an analysis of the 613 medals and diplomas which have been awarded by the jury in this exhibition. On the whole, Great Britain and Ireland hold a very fair position. Of the grand diplomas one is allotted to each of the following countries:—France, Germany, Austria, Belgium, and Great Britain. Of the ordinary diplomas to ministers, &c., France holds 11, Russia five, Italy four, the United States and Belgium three each; Germany, Austria, Sweden, and Switzerland, two each; Denmark, Great Britain, Japan, Norway, and Holland one each. Of the eight diplomas awarded to industrial establishments, &c., Great Britain has four, France three, and Germany one. Out of 11 diplomas granted to inventors, France has four, the United States and Great Britain have two each, while Germany, Italy, and Norway have one each. There are 57 diplomas of co-operation, of which Germany has 16, Italy 13, Belgium eight, France and Austria six each, Great Britain and Holland two each, Hungary, Russia, Sweden, and Switzerland one each. Out of 78 gold medals, France has 41, Belgium and Great Britain have eight each, Germany has six, the United States and Austria have three each, Switzerland two, Denmark, Spain, Italy, Norway, Holland, Russia, and Sweden, have one each. Out of 152 silver medals France has 79, Great Britain 13, Belgium and the United States 12 each, Germany nine, Italy six, Switzerland five, Austria and Sweden four each, Russia three, Spain and Holland two each, Hungary one. Out of 262 bronze medals France has 159, Belgium 28, Great Britain 15, Russia 11, Germany 10, the United States and Italy nine each, Sweden five; Spain, Holland, and Switzerland four each, Austria and Norway two each. Altogether, out of 613 awards, France has 304, Belgium 60, Great Britain and Germany 46 each, Italy 34, the United States 29, Russia 21, Austria 18, Switzerland 14, Sweden 13, Holland 10, Spain five, Denmark and Hungary two each, and Japan one.

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THE ELECTRICAL EXHIBITION AT PARIS.

Type Writers.

The necessities of business have created during the past few years a demand for type writing apparatus which can be placed in the office of the subscriber, and will convey information to him of what is being done at a central institution. In this country the Exchange Telegraph Company provides such instruments, and so far have kept well ahead in the desire to facilitate communication and introduce improvements. The exhibits of the Exchange Company at the Paris Exhibition are of two classes of telegraphic apparatus, the most important being that employed for the simultaneous dissemination of news from a centre to a large number of recipients by means of automatic type-printing instruments, and the other system being that employed for the reception of signals at a centre from instruments constructed to send a predetermined number of signals by the pressure of a button or buttons which set in motion the mechanism for automatically spelling out the message. Both descriptions of apparatus are designed with a view to the employment of many instruments upon the circuit of a single line of wire, and can be used by those possessing no knowledge of ordinary telegraphy. In the first class of apparatus is a specimen of the original 3-wire type printer first used in the United States of America for the transmission of Stock Exchange intelligence in the year 1867. This apparatus consists of two large and heavy type wheels fixed to independent axes, and rotating side by side by means of ratchet and pawl propelments, each controlled by an electro-magnet in the circuit of a separate line of wire. Beneath these type wheels is placed a band of paper, which is supplied from a reel, and passes over a cushion of soft material placed beneath the type wheels, and carried by a lever. To one end of the latter is fixed an armature, which is acted upon by a third electro-magnet, also in the circuit of a line of wire independent of the others. One wheel is engraved with the letters of the alphabet, and the other with figures, fractions, &c. To despatch a message it is necessary that both type wheels be at the zero point, one is then rotated step by step by means of an emission of current for each character until the desired letter or figure is opposite the impression pad. A current is then sent upon the third line, which causes the paper to be pressed against the type wheel and receive an impression. When a change to the other wheel is necessary the one in use is brought to the zero point, and left there while the same operation takes place upon the other. The transmission is effected by means of two commutators rotated by hand, provided with pointers and with characters corresponding to those on the type wheels engraved around their dials.

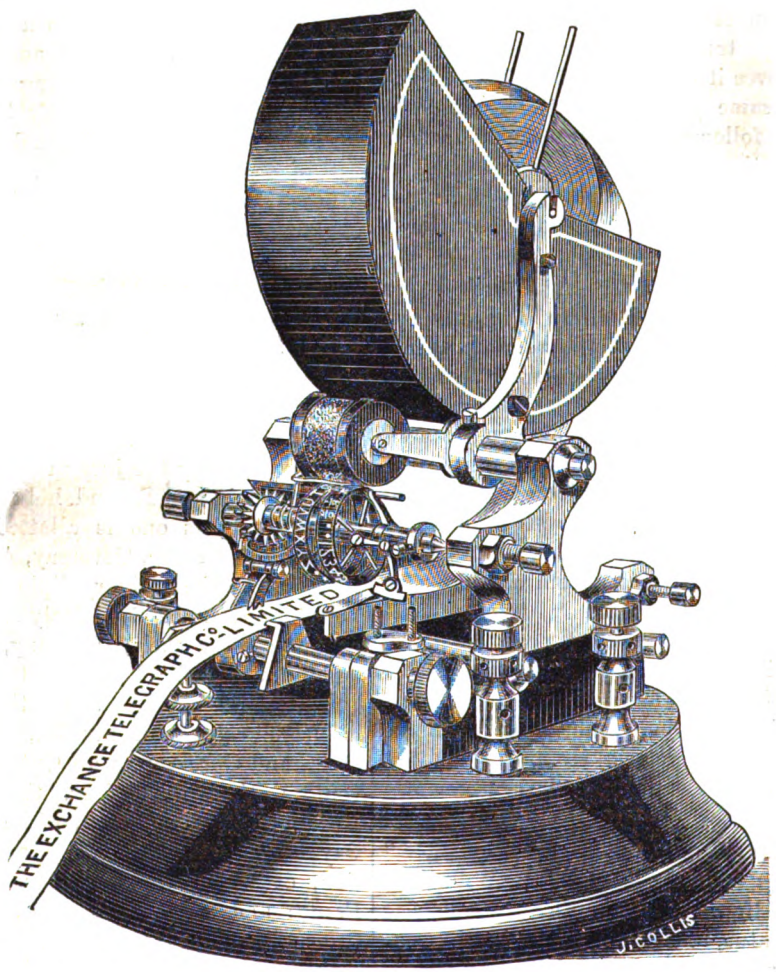
The commutators close and open the battery circuit as many times in one revolution of the pointer as there are letters, &c., on the type wheel. A key to complete the printing circuit is placed near, and is pressed when the required letter has been brought into position.

The next exhibit is an instrument showing Edison and Pope's improvements upon the previous instrument. The two type wheels are mounted on the same axis, but by means of an ingenious arrangement are made to slide laterally into and out of position for printing when required, thus obviating the necessity for the third line of wire. It contains also a very important addition of mechanism for insuring synchronism between the sending and receiving instruments. A worm upon the type axis guides the end of a lever in the course of two revolutions into the path of a pin, which radiates from the axis, and thus arrests the motion of the type wheels at the zero point. At every print this lever is set back to its starting place. When it is required to be brought into operation the type wheels are rotated two or more times, without printing, when all instruments in the circuit will be known to have their type wheels set at zero.

Another instrument exhibited, of the same kind, is constructed wholly of iron and steel, with the exception of the electro-magnets, which are wound with bare copper wire, insulation between the spirals being obtained by an air space, and between the convolutions by paper.

The fourth instrument contains Davis and Higgins' improvements on the last-described, and is that so extensively used for the transmission of financial and other intelligence in London. It resembles the Pope and Edison in appearance, and requires two wires, but the escapement is so arranged that only fifteen emissions of current are necessary to cause one revolution of the type wheels. For the three previously-mentioned instruments thirty emissions of current are necessary. The electro-magnets are made with thin tubes of soft iron, slit longitudinally. The centre of an electro-magnet core, being usually less magnetised than the part nearest the wire, acts as an armature, and reduces and retards the magnetisation and demagnetisation. The removal of this centre, and the lightening of the moving parts, enable this instrument to be worked at a speed of 950 words per hour when printing ordinary general news, or 1,500 words per hour of Stock Exchange quotations, for which the sixty characters upon the type wheels are more especially adapted. The transmitter employed for this instrument consists of a hori-

FIG. 1.



HIGGINS' TYPE WRITER.

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zontal axis with radial pins, corresponding with the characters driven by magneto electric motor. Each radial pin is controlled by one of the keys of a piano keyboard. One such transmitter in London works more than 350 instruments simultaneously, and is capable of working 800.

At present the instrument exhibited is being operated by a small automatic transmitter, which causes it to print any quantity of specimens for the visitors during the day.

The fifth instrument is similar to the above, but is furnished with much larger type for use in clubs and news rooms.

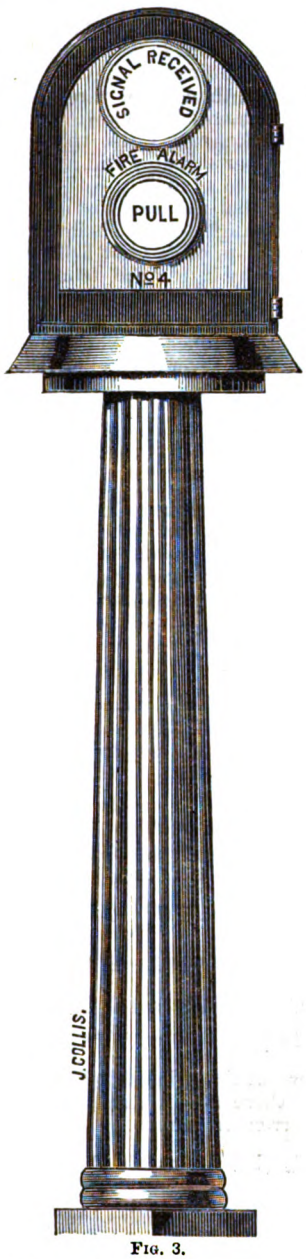

Fig. 3.

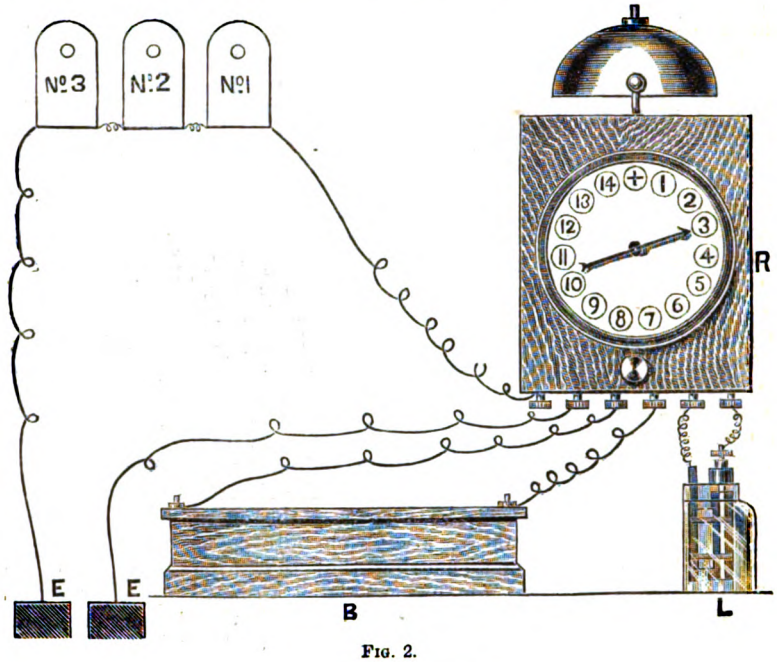

Fig. 2.

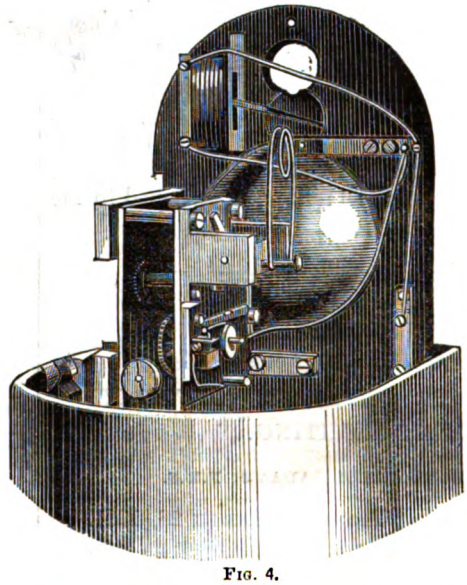

Fig. 4.

Facsimile of Printing:—

HER MAJESTYS PLATE. TEVIOTDALE WALKED OVER.

The sixth instrument is a type-printer (the invention of Mr. F. Higgins) for working upon a single line of wire. As in the previous instrument, the motive power is entirely supplied from the sending station. The propelment is attached to a powerfully-magnetised armature, which oscillates between two electro-magnets. The electro-magnet which controls the printing mechanism is in the same circuit, together with a small magnet which operates a contact maker. The latter causes the diversion of the current from the type propelling to the printing mechanism, and acts by short-circuiting or shunting the former, and opening or unshunting the latter whenever a pause takes place in the rapid reciprocal currents which are transmitted to revolve the type-wheel.

The transmitter for this apparatus, which is also exhibited, is a commutator driven by clockwork, and arranged to transmit the necessary inverse currents. Upon arresting the commutator by means of a key, when the required letter is opposite the impression lever for a very brief interval the shunt will act and cause the current to flow through the printing magnet. The interruption and re-establishment of this current will cause the letter or figure to be repeated as often as may be required without a fresh revolution of the type-wheel. Synchronism is effected as in the previously-described instruments.

Facsimile of printing:—

SEPTEMBER 13 1881.

Fire Alarm Apparatus.

Two kinds of instruments representative of the second system are exhibited. One of these is an improvement upon the fire alarm system of the Exchange Telegraph Company, which is at present employed in London by the Metropolitan Board of Works, the difference being in the manner in which

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the signals are received. In the older system they are embossed upon the tape of a Morse instrument, and require to be interpreted. In the new system the signals indicate, by means of a pointer upon a dial like that of a clock (Fig. 2), the name of the locality or number of the box from which the alarm is being made.

The means by which this result is obtained are extremely simple. A constant current is maintained through an electromagnet controlling the escapement of the receiving instrument and the signalling instruments, which are placed in the circuit of the line. To the axis of the escapement is attached the pointer or needle before mentioned. An interruption of the current causes the pointer to advance one step, two interruptions two steps, and so on. In each fire alarm box a cam wheel is provided, which automatically effects the interruptions which serve to identify its signals. The cam wheel is rotated by means of a trigger somewhat like that of a gun, which is pulled and discharged for each signal. The whole wheel movement consists of two wheels. The sender of an alarm signal has only to open the door of the fire alarm box (Fig. 3) or break the glass, pull the handle, and either shut the door and go away, or wait two seconds for the acknowledgment, which is made by the words "signal received" being caused to appear in an aperture above the handle which he has pulled. An arrangement is provided in the signalling instrument to prevent the sender interfering with his own signal when excited or flurried. Even should he pull the handle several times, or hold it out for a long time, or pull it and shut the door, no difference will be made in the reception of the signal. By the arrangement (Fig. 4) it will be seen that the only contact points in each instrument are always closed except when a signal is being made, thus ensuring that they are bright and clean when required for use. This is a great advantage over open circuit fire alarms, in which the portion of the circuit awaiting connection may decay or be otherwise removed without its loss being discovered.

Upon receipt of a signal at the fire station the bell shown upon the top of the dial commences to ring, and continues to do so until the signal is acknowledged, which is done by pressing the button under the dial. This reverses the line current, and causes the before-mentioned disc to appear to the sender, and at the same time stops the bell ringing, and replaces the pointer at zero, ready for the next signal. The boxes are mounted upon small pillars, or attached to the walls of houses as required.

CANTOR LECTURES.*

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.

BY PROFESSOR W. GRYLLS ADAMS, F.R.S.

LECTURE IV.—DELIVERED MONDAY, MARCH 28, 1881.

(CONTINUED FROM PAGE 381.)

Mr. Alexander Siemens lays down, in his paper on "Electric Lighting," that 4lbs of coal, costing 15s. a ton, will produce one horse-power of energy per hour, and that, if a steam engine be employed to produce an electric light of 6,000 candle-power, the cost would be 5d. per hour. If the same illumination be produced by 15 lights of 400 candles each, the cost would be 2s. 1d., or five times as much. Hence the cost for a 400 candle light would be at the rate of about 1 2-3d. per hour.

Now, by comparison, we may get some idea of the price of the electric light when obtained by means of the Werdermann or Joel lamp. If we compare the light obtained by the Joel or Werdermann lamp with that from the 400 candle light from the arc, we get about 320—or, say, 300—candle-power in the Joel light for 800 candle-power in the other. Hence the price of the electric light from a Joel lamp should be at the rate of 6½d. per hour for a 600 candle-power light.

Now, according to Mr. Alex. Siemens's estimate for gas, the price of gas would be at the rate of about 5 4-5d.—or nearly 6d.—per hour for the same light. In other words, the cost of the electric light from the Joel lamp would be nearly the same as gas at the rate of 4s. per 1,000 cubic feet.

In estimating the candle-power of lamps, it is usual to place the photometer on the same level with the lamp, so that the surface is illuminated by the rays proceeding horizontally from the lamp. Now in all lamps, whether Werdermann or arc lights, which are fed by a continuous-current machine the current passes from the positive carbon to the negative always in the same direction; and in the arc lights the upper positive carbon becomes worn away into a hollow; hence a portion of this carbon obstructs the light, and the greatest intensity of light is not in a horizontal direction, but downwards, at an angle of about 60° below the horizontal. The illumination in this direction is about three times—or even more than three times—the illumination in the same horizontal plans with the arc; hence when it is said, in the report of the Glasgow tests, that a dynamo-machine, at 1,200 revolutions per minute, will give a light of 2,060 candles for an expenditure of 4 h.-p.—the light being measured horizontally—we see that the illumination, in a direction inclined downwards at an angle of 60° below the horizon, would be 6,500 candles for 4 h.-p. or at least 1,625 candles per h.-p. This will also explain why lights fed from continuous-current machines should be placed at a considerable height above the area to be illuminated. This, combined with the fact that it is far more economical to produce one very powerful light by means of a large machine, than several smaller lights to illuminate the same area to the same degree, will explain why Dr. Siemens is erecting his large lamps at so great a height for the trials of electric lights which we shall shortly have an opportunity of seeing in the City.

SUB-DIVISION OF THE ELECTRIC CURRENTS.

The next point to which I propose to draw your attention this evening is the sub-division of the electric current.

It will be simplest to regard first the case where there is a battery of given electromotive force. In this case, according to Ohm's law,

$$E = C (R + r),$$

where E is the electromotive force, C the current, R the resistance of the battery, and r the external resistance. If the poles of the battery be joined by two separate resistances r_1 and r_2,

$$\text{then } E = C \left(R + \frac{r_1 + r_2}{r_1 + r_2}\right).$$

If the resistance of each branch is equal to r, and if C_1 be the current in each,

$$\text{then } E = C (R + r) = 2 C_1 \left(R + \frac{r}{2}\right).$$

Let E = 100 volts, R = 1 ohm, and r = 100 ohms,

$$\text{then } 100 = C (1 + 100) = 101 C,$$

$$\text{and } 100 = 2 C_1 (1 + 50) = 102 C_1.$$

Hence nearly the same current flows in each branch as when there is only one wire. If there are 10 branches instead of 2 branches, and if Cx be the current in each,

$$\text{then } 100 = C_x (1 + 10) = 110 C_x,$$

i. e., the current in each branch is $\frac{100}{110}$ instead of $\frac{100}{102}$. If there are 50 branches, and Cy be the current in each,

$$\text{then } 100 = C_y (1 + 2) = 150 C_y$$

thus the current in each is $\frac{100}{150}$ or $\frac{2}{3}$, and the heating or glowing effect is $\frac{4}{9}$ths of its value with only one branch.

Now, if with 50 branches in multiple arc, we diminish the external resistance of each branch so as to get the same current as at first through each branch,

$$\text{then } E = C (R + r) \text{ at first,}$$

$$\text{and } E = 50 C \left(R + \frac{r_1}{50}\right) \text{ with 50 branches.}$$

$$\text{So that } (R + r) = 50 R + r_1,$$

$$\text{or } r - r_1 = 49 R.$$

Hence with R = 1 and r = 100 ohms $r - r_1$ = 49 and the length

* Reprinted from the *Journal* of the Society of Arts.

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left has a resistance of 51 ohms. The heating of each of these is $\frac{51}{100}$, or one-half of what it was with only one branch. Hence the glowing heat or light from such a resistance will be greater than from the unshortened wire, with the weaker current through it. In this case we get 50 circuits of 51 ohms each, so arranged that the heating effect in each circuit is ·51, or about one-half of what it was at first. Hence the amount of heat radiated from each is one-half of what it was at first. But there are 50 such circuits, therefore the total heat radiated is 25 times as much as it was with only one branch.

If the resistance of the battery and connecting wires is considerable, then we see that the addition of every additional branch circuit takes away greatly from the amount of heat radiated from each branch, so that this plan of sub-division by separate circuits can only be adopted with success when the internal resistance is small as compared with the external resistance. We see, then, that with small internal resistance there is great gain in heating, and, therefore, in light-giving power, by arranging branch parallel circuits in multiple arc; but when the resistance of the battery and leading wires is considerable, the advantage of this arrangement is small, and very little sub-division is admissible.

Incandescent Lamps.

Now, let us consider the case of currents produced by means of dynamo-electric machines, in which the electromotive force is not constant in the same machine for the same speed, but depends upon the resistance of the circuit. An electromotive force of 100 volts produces a current of one weber through a resistance of 100 ohms, and Mr. Swan tells us that this current, through a lamp of that resistance, gives a 60 candle-power light. Now, if we reduce the length of the carbon filament in the lamp without altering the current, we reduce the illuminating power in the same ratio. Suppose we take it as four-fifths of the length, *i.e.*, its resistance is then 80 ohms, and we shall get a 48 candle-power light from the same current (one weber), *i.e.*, with an electromotive force of 80 volts.

With two such lamps in series, we shall get two 48 candle-power lights, with an electromotive force of 160 volts, sending a current of one weber through them *i.e.*, the two lamps should give out a light of six gas-burners of 16 candle-power each, and should be sufficient to illuminate a drawing room in many of our London houses.

If we consider now how we are to produce the current, we find that a Bürgin machine, by the expenditure of six horse-power, will send a current of 24 webers through an external resistance of about 7 ohms, giving an electromotive force of 160 volts. If, then, we take two lamps in series, *i.e.*, 160 ohms, and arrange 24 distinct series, we shall get a combined resistance of $\frac{160}{24}$, or about 7 ohms, allowing for the resistance of connecting wires, and there will be a current of 1 weber through each circuit, *i.e.*, this machine should give us 48 lights each of 48 candle-power. With a resistance of 50 ohms in each lamp, the number of lamps which may be supplied from the same machine will be double this number. If we reduce our electromotive force from 100 volts to 80 volts, with the same length of carbon in the lamp, then we reduce the current from 1 weber to 8-10ths of a weber. This in the same resistance will reduce the illuminating power from 60 candles to a light of about 40 candle-power, instead of a light of 48 candle-power. Hence, with a given electromotive force, more light is obtained, and, therefore, greater economy is effected by shortening the length of the carbon in the lamp, rather than by diminishing the current through the same length of carbon. Hence, the best results will be obtained in incandescent lamps by sending through them as strong a current as they will safely stand, and making the length of carbon such that the dynamo-machine employed will send such a current through them.

Take another case:—Suppose we have one lamp of 75 ohms resistance (*i.e.*, about 45 candle-power). A Gramme machine or a Siemens medium-sized machine will give an electromotive force of 100 volts, and a current of about 25 webers, at the rate of 100 revolutions a minute, through an external resistance of about 3 ohms. Hence, if we have twenty-five lamps in separate branch circuits, or in multiple arc, we get one weber through each from such a machine, and get a light, according to Mr. Swan, of 45 candle-power from each. Hence, such a machine will give us about 1,125 candle-power illumination. The energy expended would be about 5 or 6 h.-p., so that the illumination would be about 200 candles per h.-p.

We have seen above that, with the Siemens alternate current machine, a 400-candle light requires about half a horse power; so that 1 h.-p. will supply two lights of 400 candle-power, from an alternate current machine, at the rate of 10d. for three hours. The same illumination can be obtained from gas at 2s. for three hours. Now, two-thirds of this cost is for the supply of carbon, which becomes burnt in the arc. Hence, without this consumption of carbon, the expense per h.-p. is only 10-9ths of 1d. per hour. Applying this to the case of incandescent lamps, in which our carbons do not wear out, we see that by a proper arrangement of the lamps we may get a 200 candle-power light at the rate of 10-9ths of 1d. per hour.

Now, Mr. Alex. Siemens also states, in his paper, that at the rate of 3s. 6d. per 1,000 feet, the same illumination cannot be obtained from gas at less than 2d. per hour. Hence, allowing 8-9ths of 1d. an hour for the breakage of incandescant lamps, the cost of light by gas and by incandescent electric lamps would be nearly the same.

If we allow that only a light of 40 candle-power, instead of 60 candle-power, can be produced at this rate, still the incandescent light cannot be regarded as an expensive light.

Now, in the absence of any actual determination, let us assume the same law to hold in the Brush system as in the Siemens or the Gramme system. In the Brush system a current of 10 webers is sent through an internal resistance of 10 ohms and an external resistance of 70 ohms. Now, in the Siemens machine, when the external resistance is seven times the internal resistance the current is only 1-60th part of its value when the external and internal resistances are equal, and 1-40th of its value when the external is double the internal resistance. The drawback to this arrangement would be that one-third of the total work expended would be lost in heating the machine.

Taking the Brush machine as worked at present, the difference of potential for each of 16 lamps in circuit is about 40 volts. Hence total difference of potential of 16 lamps = about 640 volts. With an external resistance of 70 ohms, there is a current of 10 webers. Hence, if we arrange incandescent lamps in 10 series, so as to get a resistance of 70 ohms, we shall get 1 weber through each series. Put, then, 7 lamps, each of 100 ohms resistance, in each series, and we shall get 70 lamps from a Brush machine. These 70 lamps are each of 60 candle-power, and all are worked by an expenditure of 16 h.-p. Hence the candle-power is 4,200 candles from 16 h.-p., or 262·5 candle-power per h.-p. If the lamps of this resistance are only heated, so as to give a light of 30 candle-power each, then the candle-power per h.-p. will have to be reduced.

Thus we have seen that it is possible to sub-divide the electric current in such a way as greatly to increase the amount of illumination which may be obtained by means of a dynamo-electric machine, especially when the light is accomplished by the incandescent system of Swan, Lane-Fox, or Edison.

The earliest attempt to obtain light by incandescence in a vacuum was made by King, in 1843, who applied continuous metallic and carbon conductors, and heated them by an electric current in a Torricellian vacuum. He was followed in 1848 by Staite, who used an aridium, or an iridium and platinum wire, and enveloped the holder in glass or some other non-conductor. In 1872, Konn employed graphite, and rendered it incandescent in an atmosphere of nitrogen, in which there was no wasting away of the carbon. The same principles have been followed, but with greater promise of success, in the more recent attempts at producing illumination by means of incandescence. The earlier attempts failed, either (1) because of the impossibility of preventing the consumption of the carbon or other material, in consequence of the minute traces of air, which it was impossible to get rid of with the means of exhaustion which were then known; or (2) because of the presence of other gases, such as hydrogen, which exists occluded in platinum and in other substances. It is only quite lately, since our power of obtaining a vacuum has been so greatly extended, and since we have learnt so much about high vacua from the labours of Mr. Crookes, that Mr. Swan and Mr. Lane-Fox have succeeded in obtaining vacua from which all the air and occluded hydrogen are exhausted, so that their carbon filaments and platinum wire connections remain without being destroyed, even when a current of electricity strong enough to make them give out a brilliant incandescent light has been continuously passing through them for months together. Through the kindness of Mr. Swan, and of my friend and former pupil, Mr. Lane-Fox, I am able to show you this evening how well they have succeeded in producing a brilliant, and yet a steady and pleasant, incandescent light. This is a triumph which many have sought in vain, and which could not have been attained except by combining together the results of investigations which have been recently carried on in several branches of physics.

I cannot conclude this course of lectures without giving my especial thanks to Mr. H. Trueman Wood, who has given me very valuable assistance, by helping me to bring together a large collection of electrical apparatus, in illustration of the interesting subject which I have had the honour to bring before you.

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TO CORRESPONDENTS.

We are compelled to leave over several letters to our next issue. Will Mr. Arthur Wright kindly send us his full address?

A NEWLY-INVENTED GRIEVANCE.

Making every allowance for the exigencies of the dull season, we confess to being staggered at the audacity displayed by one of our daily contemporaries last week, who, with all the solemnity appropriate to the performance of a public duty, launched its vexed soul against the telegraphs. It appears that the public are suffering, at the hands of the Postal Telegraph Department, a most painful injustice, the instant removal of which is "demanded with almost an universal voice." The one grievance, which alone—barring, of course, the continuance of the shilling rate—serves to stamp the administration as obstructive and retrogade, is that "the postal telegraph offices all over the kingdom continue to be closed when they ought to be open." This is news indeed; and that there may be no mistake about it we are further assured that "at the very hours when the telegraphic system is most necessary, this method of communication is absolutely cut off." Curious to know what these "most necessary" hours can be that are denied to the public, we find on further study that they are those between a "certain hour in the evening and the following morning," and also during the greater part of every Sunday. It is true that the offices at all large towns are open always, and at many more are available during the greater portion of every twenty-four hours; but at such vitally interesting places as Sydenham, Chislehurst, and even Hampton Court, the telegraph wires can be set in motion only during twelve or fourteen hours of the week-day, and hardly at all on the "dreary Sabbath." "At all hours of the day and night any one can telegraph to America, India, and Australia," continues our informant; "but for no sum of money could we telegraph for a lad home from Harrow on the seventh day of the week." This is bad enough, but graver inconveniences follow. "The most anxious efforts of kind friends and affectionate relations are paralysed by the fact that the telegraph offices are closed; an accident happens requiring first-class skill;" or, more dreadful to contemplate, "some one may want to repair a grievous wrong done to a woman," and be unable to "legitimise an unborn child"—we are quoting the actual words—all because the message of warning or of peace "cannot be flashed through the useless and idle wires."

It would at first sight appear needless to waste words on such extravagance as this; but because it is such palpable and unmitigated nonsense we are the more inclined to suspect that it masks a purpose of some more serious moment. Nobody, not even the young lions of the *Daily Telegraph*, would start an imaginary grievance, and magnify it into seeming reality, all the while knowing it to have practically no existence, unless to remove some personal grievance which they do not care to boldly confess. In the course of the article we are referring to, "Sunday" is mentioned scoffingly in several places, and the writer protests against the telegraph being burdened with the moral restrictions of Sabbatarian crotcheteers. We are not concerned to defend Sabbatarianism, but we are only following the usage of every civilised community all over the world in defending a one day's rest; and we take it that most people in this country value that day so much—if merely as one of great practical utility—that they would bear to be called Sabbatarians rather than sacrifice it. If there is one sect more Sabbatarian than another it is the one with which our contemporary is commonly supposed to be most intimately associated; and, to put it plainly, the advocacy of abrogating the Christian's day of rest comes with a very bad grace from people who would indignantly repel any invasion of their own. It is perfectly certain the general public do not desire a prolongation of the hours of attendance at telegraph offices, and that they accept the inconvenience—such as occasionally may arise—from partial non-attendance on Sundays as a reasonable restriction. But, on the other hand, it is notorious that a certain section of the community given to commercial and financial pursuits would like to put the wires in full operation, and indeed set business generally in active motion all through the "dreary Sabbath day." Our contemporary too ostentatiously sets these interests aside, and professes to rest its case on the sentimental consideration we have above described. We may leave it to our readers to judge whether this can on any reasonable hypothesis be the real ground.

Of course it is not to be denied that now and again some irate person writes to the newspapers complaining that on a certain evening he could not send a message to Little Pedlington because the office is closed for the night. He is naturally provoked; but he never goes the length of asserting that this is the very hour the telegraph is most needed; and probably the next day's reflection suggests the consideration that if every Little Pedlington, to be of any use at all, had to be manned and messengered without intermission—for this is what the *Daily Telegraph* explicitly demands—there would be no wires at Little Pedlington to use. Then, again, as regards the Sunday grievance, it is true that what few private messages are offered on that day are generally of the urgent sort, and if they cannot be forwarded there is disappointment. So, too, will there be disappointment if a train is required on a pressing errand when no trains are running. It would

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not be much use telegraphing for "a son to come from Harrow" if there were no train to bring him; nor would the telegraphing for a "first-class doctor" be invariably responded to with promptitude unless "first-class doctors" are never to go to church. The simple fact is that our telegraph system is timed pretty closely in accord with our social system; and unless we are prepared to rudely break in upon it, or disregard it altogether in the interests of a very active but numerically small portion of the community there is no call to make any considerable addition to the number of hours during which telegraph offices are kept open; indeed, looking at the tendency of the last ten years, there would appear to be good reason rather for reducing than increasing those hours. Business is over earlier by many hours than it used to be when the time for closing was fixed at 8 p.m.; there never was much to speak of before 9 a.m., and nowadays there is still less. Working days are, in fact, becoming shorter; and although in large towns pleasure is taken later, in the vast majority of towns pleasure forms no part of the traffic on the wires, and they probably might be closed earlier without any inconvenience or loss.

We have treated the proposition of our contemporary more seriously, perhaps, than it seems to deserve. A proposition which includes a truckle bed to lodge an operator and a messenger at every telegraph office in the kingdom, who are "to be used in case, but only in case, of emergency," does not look promising; nor, indeed, does the writer seriously mean it, any more than the agitators mean it when they use similar arguments against the restrictions upon postal deliveries on Sundays. Agitations of that kind, however, have assumed formidable dimensions at times, and for the simple reason that where there is one proved grievance there are always a score of people ready to denounce it, though they have no grievance of their own. The only way to meet them is to show that the removal of a slight inconvenience in one quarter might necessitate the inflicting of a very great one in another quarter. And this could be very easily proved to be the case in regard to the telegraphs, as it has been proved many times in regard to the Post Office. It is true that one can send a telegram from Liverpool to New York or Bombay at all hours of the night, and on all days of the week, and there are obvious reasons—geographical reasons amongst the number—why we should continue to do so; but there is no good in being able to send where we never want to send; whilst, on the other hand, there would be immense hardship entailed by keeping operators and messengers in readiness for the off chance that some night we might have reason to change our minds. The Postmaster-General is appealed to to crown his list of reforms by conferring this undesirable boon on the community at large. He certainly will not be deceived by the ostensible pleas put forward; and the actual community at large do not in fact desire the boon.

Underground Telegraphs in Philadelphia.—The work of laying the conduit for the underground telegraph system in Market-street has proceeded as far as Eleventh-street east from the public buildings, and work is progressing at the rate of half a square a night. The conduits have twenty separate chambers. Each chamber has a capacity for fifty wires, and connection is made by means of manholes, which are located at each square.—*Philadelphia Record.*

Electric Light in New York.—A New York contemporary of recent date exclaims:—"At last Edison is about to do actual work, the laying of an elaborate system of conductors for the electric light having been commenced in the lower business district of this city."

THE ELECTRICAL EXHIBITION AT PARIS.

Clerk's Gas Engine.

Of the gas engines at the Exhibition, that which attracted most attention is a new engine designed and patented by Mr. D. Clerk, and manufactured and exhibited by Messrs. Thomson and Sterne, London and Glasgow. To those who have paid any attention to the development of the modern gas engine it is well known that to obtain the most useful effect from the consumption of a given quantity of gas it is necessary to compress the combustible charge of gas and air previous to ignition, and to employ a power cylinder which has a considerable space not swept through by the piston, this space being necessary to contain a considerable quantity of air, or mixed gas and air, which, especially when initially compressed, acts as a cushion to absorb part of the shock due to the sudden rise of temperature on ignition and explosion of the charge, and being thus heated to expand and do work on the piston. When no such cushioning charge was employed, the piston received a sudden impulse, but of momentary duration, and, instead of a cushioning

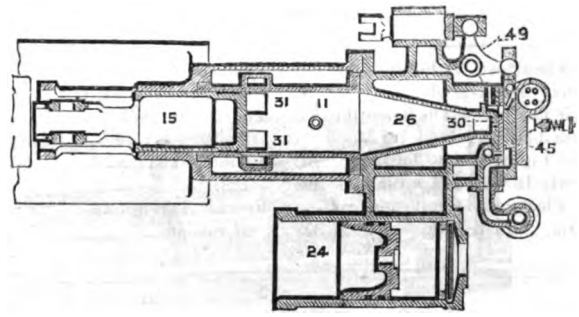

Fig. 2

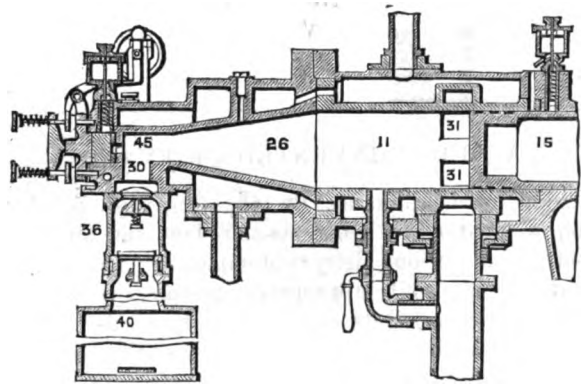

Fig. 3

charge to absorb some of the heat due to combustion, and give it up in useful expansion, the walls of the cylinder were so heated as to cause great trouble; in fact, very few or none of the engines made without this provision for the cushioning charge of gas and air are now to be seen. An objection has, however, accompanied the improvement, which has made economical and high-speed engines possible. This is the fact—that only one ignition for every two or three, and, in some cases, four revolutions could be made, because one stroke at least of the piston was necessary to remove the residuum of the products of combustion which were not expelled on the exhaust of those products. In the engine of which we have above spoken, and which we illustrate herewith, the difficulty is overcome by employing what the inventor terms a "displacer" cylinder as well as the power cylinder, and by this means the space in the power cylinder which is provided for the expanding cushioning charge is cleanly exhausted at every revolution, and thus ignition may take place, and the piston receive an impulse at every revolution. It may be asked why this could not have been done with engines previously made, and the answer is that the residium already referred to caused the premature

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explosion of the gas, and this even takes place now with engines which have not a sufficient scavenging charge.

A general view of the engine is shown at Fig. 1. Fig. 2 is a horizontal section of the cylinder, &c., and Fig. 3 is a vertical section through the same.

The crank pin, to which a rod is connected for working the piston in the displacer cylinder 24 (Fig. 2), is 90 deg. in advance of the power crank. The pressure in the displacer cylinder does not exceed 5lb. per square inch, so that it and its connections are light. When the displacer piston moves forward, and for the first half of its stroke, the combustible mixture of gas and air is drawn through the lower valve in the box 36 (Fig. 3) into the cylinder. Gas is then cut off, and during the remaining half of the stroke only air is drawn in. The displacer piston on its return stroke discharges its contents through the upper valve in the box 36, through the entrance 30 at the small end 45 of the conical part 25 of the power cylinder 11. The box 40, below the valve box 36, is simply an air chamber into which air is drawn previously to entering the valve box so as to prevent noise. On its return stroke, as we have said, the piston in the displacer cylinder discharges its contents through the upper valve in box 36 into the power cylinder, the piston 15 of which is hot from the heated products of combustion of the last stroke, and is at the outer end of its stroke as shown in Figs. 1 and 2. In this position it has uncovered the exhaust ports 31, and the power cylinder is filled with fresh air, some of the first of which expels and escapes with the residuum of the products of combustion. The power cylinder is now filled with the charge of combustible mixture of gas and air. The motor cylinder piston at its instroke compresses the charge into the conical space 26 at a pressure of 45lb. per square inch. Ignition then takes place, and the pressure rises to from 200 to 250lb. per square inch. The cycle of operations so far as described is now repeated. It will have been gathered that the capacity of the displacer cylinder is greater than the combined capacities of the motor cylinder and charge space 26, as not only must its contents fill these after some of the air it supplies has passed through the exhaust for scavenging purposes, but the explosive mixture is only allowed to occupy about one half the volume of the displacer cylinder. Of course the gas and air gradually intermix, but there is not time allowed for the explosive mixture and the pure air to commingle to any detrimental extent. In the engine there is no exhaust valve, and the admission valves, as will have been seen, are of a simple character. The slide valve, shown at the end of the cylinder (see Fig. 2 at 45), and worked by the bell crank lever 49, and its connections with an excentric, serves to cut off the supply of gas to the displacer at half its stroke, and to ignite the charge at the proper time. The ignition slide 45, Fig. 2, has in it a small cavity, from each end of which is a port opening at opposite faces, that is opening on to the cylinder end face and the slide cover face. At one end of this cavity there is a perforated plate, through which combustible mixture passes from the motor cylinder, the communication being made by a small hole in the slide and a gutter in the slide face, which is constantly on the hole cylinder and face leading to the conical combustion chamber. The lighting mixture, after passing through the perforated plate in a small cylindrical open-topped vertical chamber, seen in plan in Fig. 2 and in elevation in Fig. 1 at the end of the cylinder, is lighted by a small Bunsen burner, not shown, which, burning at the grating, fills the cavity with flame, which on the motion of the slide valve is admitted direct to the combustion chamber.

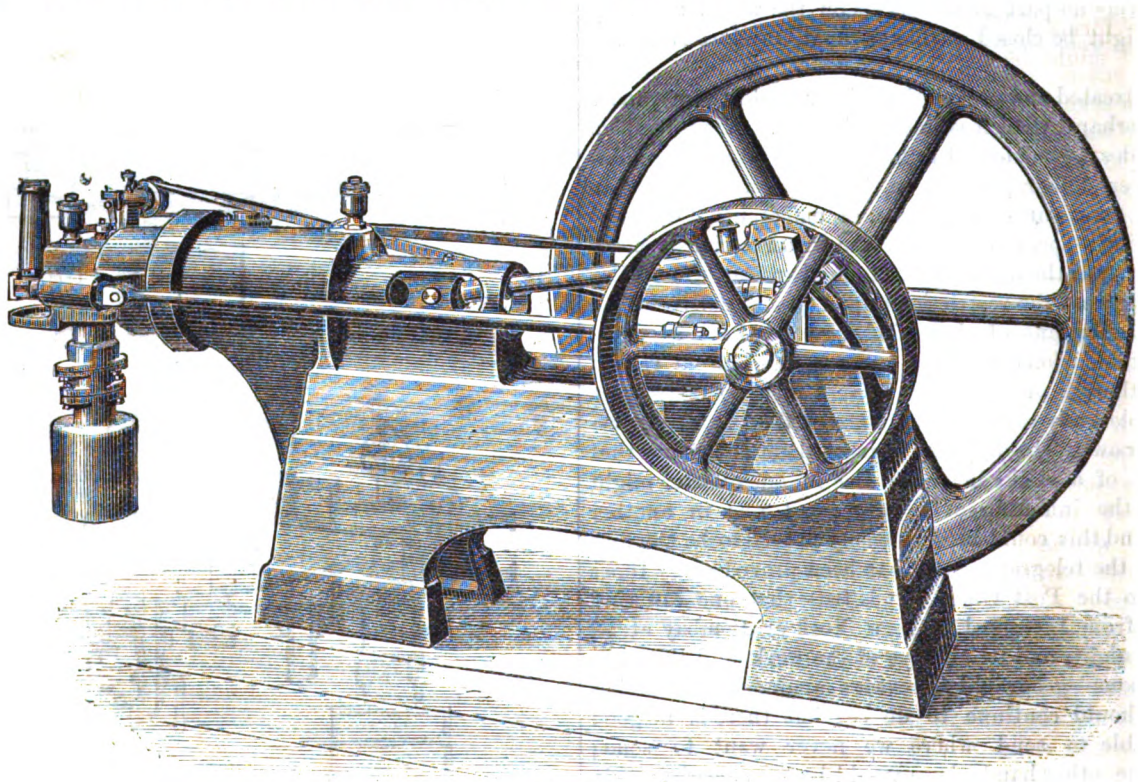

Fig. 1.

The ignition port and the gutter are so arranged that the slide cuts off all communication with the atmosphere before communicating with the cylinder or at the moment of doing so. The ignition port has an area of but 0·125 square inch in the engine exhibited, which is of 6 horse-power nominal, giving 10 horse-power on the brake at 145 revolutions per minute. The pressure on this valve, which is itself very small, is thus inconsiderable. With the arrangement of port and igniting chamber and burner as described there is no necessity for ventilating the ignition port, and the frequency of ignition is anything that may be desired.

The engine is well designed; its arrangement is simple, though there are some details which for clearness have been omitted from our sketches, and the engine promises to be highly successful, a result which is largely due to the fact that, owing to its giving an impulse from ignition at every stroke, an engine of a given size has its power nearly doubled as compared with other engines of this class.

Dynamo-Electric Machines.

Ball's Machine.—We have previously called attention to the similarities and differences between Dr. Hopkinson's

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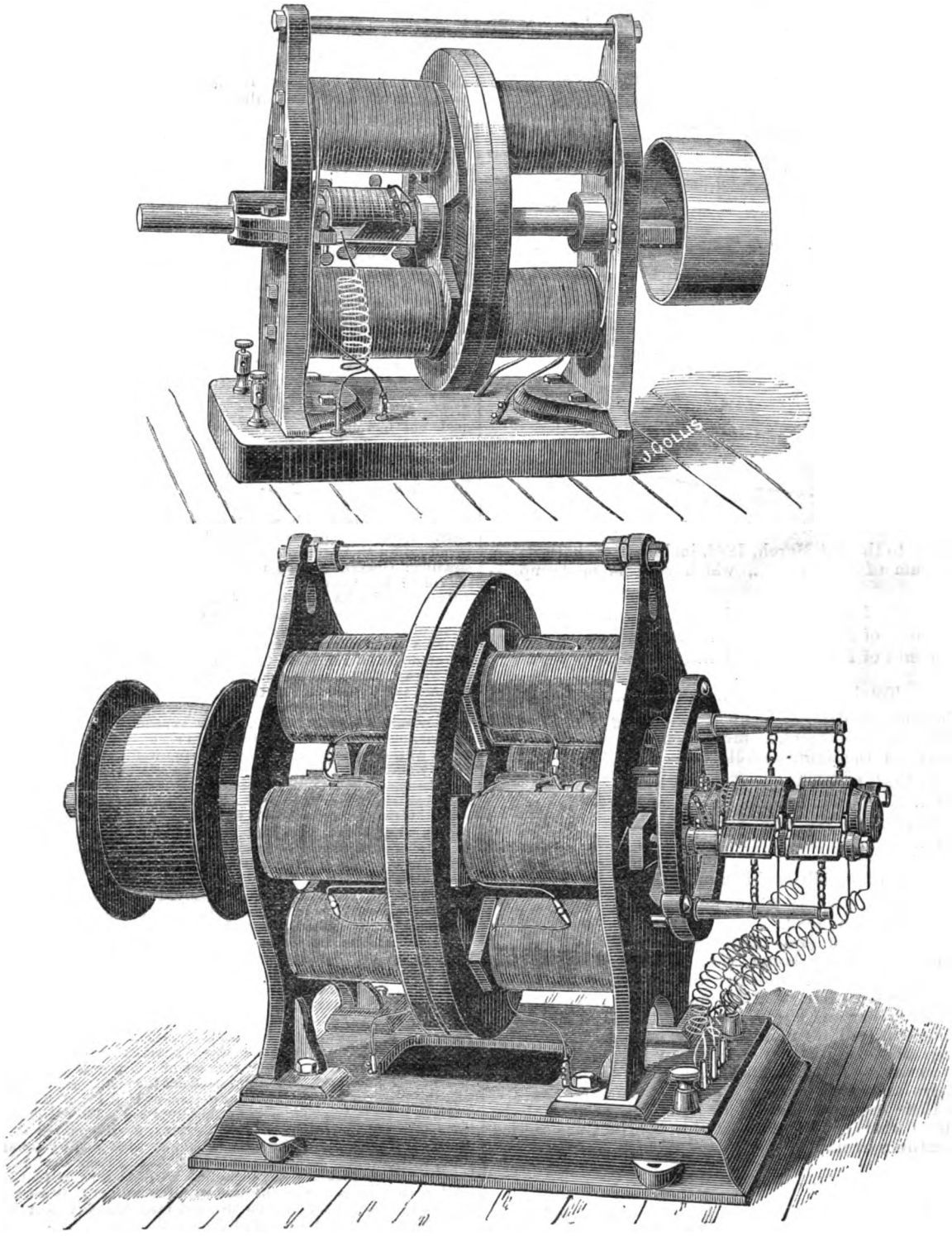
machine, Siemens' machine, and a third machine shown in the American Section. We shall now briefly describe this last machine, which has attracted a considerable amount of attention. It is the design of Mr. C. M. Ball, and is manufactured by the White House Mills. Several machines are shown, but we have not been able to see them at work; nor have we any facts or figures except at second, third, or fourth hand, to indicate the capabilities of the invention. These, however, must soon be obtained, as the machine has rather a taking appearance. We have heard a good many comments on it, but only one adverse, and that related to the possible difficulties to be encountered in the manufacture, in winding the magnets. Two classes of machine are shown, simple and compound. In the above figures we illustrate both the simple and the compound machines. The armature of the simple machine, as will be seen from the first figure, is made up of six horseshoe-shaped coils—somewhat similar, in fact, to the coils in the Siemens and in Dr. Hopkinson's machine. The peculiarity of these coils is that they have no core; they are joined together to form one continuous ring, and at the points of junction connections are made with the plates of the commutator.

Thus the number of commutator plates and the number of coils are equal. The plates of the commutator are set at an angle of 30 deg., so that two opposite coils of the armature are cut out of the internal resistance during one-twelfth of a revolution, decreasing by so much the internal resistance. This, if we mistake not, is claimed as one of the specialties of the Brush machine, so that the principle is not new. The real question which this machine will assist in solving is whether the principle adopted by Dr. Hopkinson to have the cores of his armature coils filled with iron, that of Siemens to have merely an open bobbin upon which to coil the wire, or this of Mr. Ball to have no core at all, is best.



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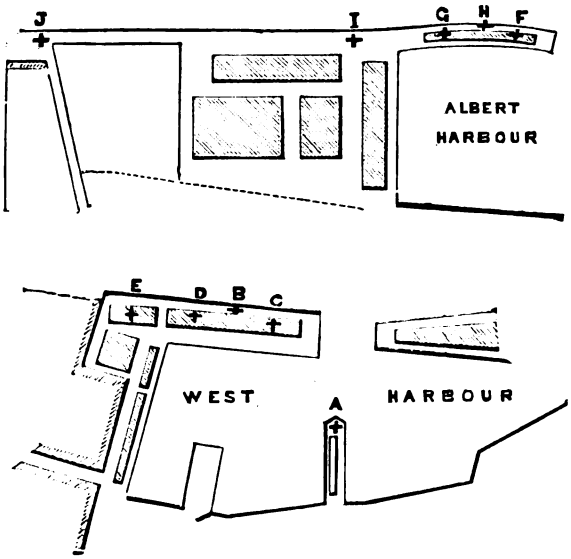
GREENOCK HARBOUR.

We herewith give a plan of Greenock Harbour, showing the positions in which it is proposed to place electric lights. At the points marked A, B, H, I and J the lights are to be of 6,000 candle-power, while at the points marked C, D, E, F and G lights of 3,000 candle-power are required. The requirements by the trustees are embodied in the following paragraph, issued to contractors:—The whole of the above described lights to be of the most approved kind, with all the modern improvements known, erected complete and lighted and worked by the contractors every night, between sunset and sunrise, from the 1st



December, 1881, to the 1st March, 1882, inclusive of both dates, for the lump sum of £ „ „ which sum is made up as follows:—

For the month of December, 1881	£	„	„
For the month of January, 1882	£	„	„
For the month of February, 1882	£	„	„
Total	£	„	„

Also, if the trustees determine upon extending the term of this contract, the contractors must continue to light and work the whole of the lights as follows:—

1st March, 1882, to 1st April, for the extra sum of	£	„	„
1st April, 1882, to 1st May, for the extra sum of	£	„	„
Total extra for additional two months ...	£	„	„

or a total of £ „ „ for the whole five months, from 1st December, 1881, to 1st May, 1882.

The above sums to include the supply and erection of all necessary poles, guys, wires, lamps, &c., all necessary engines, batteries, and machinery for working the lights, together with the motive power for same, whether gas, water, steam, or any other power, all labour and wages for erecting and working the lights, together with all tools, implements, hoardings, and erections, carriage and everything necessary to insure the proper and efficient working of the lights to the specified power, and also all repairs and maintenance to the satisfaction of the trustees and their engineer, Mr. W. R. Kinnipple, who shall be sole judge as to whether the terms of this contract are carried out in their entirety or not.

Electric Light in Glasgow.—At a recent meeting of the Glasgow Institute of Architects, Mr. John Honeyman, F.R.I.B.A., made some very strong remarks, animadverting upon the proposal of the Glasgow Corporation to secure a monopoly of electric lighting in the city and suburbs. He drew a doleful picture of the extortion that would probably be practised, saying that they would charge whatever they chose for the supply of electricity, and interfere with the use of apparatus which the user might prefer, allowing no choice of accumulators, lamps, or anything else.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY (LIMITED).

The sixteenth ordinary general meeting of the shareholders of the Brazilian Submarine Telegraph Company (Limited) was held at the Cannon-street Hotel on the 28th ult., under the presidency of the Right Hon. Viscount Monck.

The Secretary (Mr. Richard Collett) read the notice convening the meeting and the minutes of the last meeting, which were confirmed by the present meeting and signed by the chairman as correct. The report, which has appeared in *The Electrician*, was taken as read.

The Chairman said he would first refer them to the table published at the bottom of the report, showing the receipts every year since the cable commenced its operations, and he thought that the facts disclosed by that table were, to say the least of it, not unsatisfactory to the shareholders. Beginning in the year 1874-75 with receipts of £128,000 in round figures, they had been creeping up gradually every year to £167,000 in the present year. He did not think that that could be otherwise than satisfactory to the shareholders. It showed a sound and gradual increase in the receipts of the cable, and there had been concurrently a gradual increase of what they often had some discussion about at their meetings, namely, the reserve fund, which now stood, at the present price of the investment, and taking into account the cable which they possessed, at a total of £389,761 [hear, hear]—of course, including the £50,000 which was proposed to add to the reserve fund for the past year. There was also another subject for congratulation in the fact that the gradual increase in the receipts, and in the reserve fund had been accompanied by a gradual cotemporaneous increase in the net receipts of the shareholders. Last year they had received 6 per cent, and this year they would have 7 per cent.; and he could only assure them, as he had often assured them before, when they were, perhaps, not in as flourishing a condition, as regarded dividend as they were at present, that it would be most gratifying to his brother directors and himself if they could give them, not 7 per cent., but 20 per cent. As soon as they were satisfied that they could do so consistently with the maintenance of the concern, they would give them every shilling they earned beyond what they thought was absolutely necessary to set aside in order to secure the permanence of their dividend [hear, hear]. With regard to the expenditure the accounts were made out on a uniform principle every year, and, therefore, they could all, without the slightest difficulty, compare what the outgoings of the Company were one year, or one half year, with another. The expenditure, as compared with the previous half year, showed an increase of £967, which was all at the out stations, the general expenditure in London having decreased by £59. The increase at the out-stations was brought about by certain special payments, which would recur periodically, but certainly not every year. Thus, they had been obliged to spend £454 in the purchase of new furniture for their stations, and they had had to pay £149 duty to the Brazilian Government on the importation of those articles into Brazil. [A Voice: What about Free Trade?] The hon. shareholder had anticipated a remark which he was about to make. These two items made £600 out of the £967, and, though that was not the place to discuss the question, the £149 duty which they had had to pay to the Brazilian Government might afford a certain argument against the doctrine which was being ventilated out of doors in reference to Free Trade in this country. Then they had had to pay £120 more for new taxes imposed on them at Pernambuco and Lisbon, and the balance of the increased expenditure had been for renewal of buoys, &c., and certain legal expenses at Pernambuco. As he had already said, a certain portion of this expenditure would recur at different periods, but not now for some time to come. He therefore thought that, as far as the expenditure of the Company went, things were also in a satisfactory state. He might add, in reference to the receipts of the cable, that the increase which he had notified to them up to last June, which was the half year with which they were dealing, had since continued, and they were now receiving a larger income than they had ever received before from the cable [hear, hear]. He then referred to, and expressed the regret of his co-directors and himself, at the death of their late colleague, Mr. W. H. Clark, who was most assiduous in the discharge of his duties, and who was associated with the Company from its conception. Standing there as the representative of their managing body, there was another point which he had to mention. The directors had always endeavoured to take the shareholders into their confidence, and to have no secret from them. The point which he had to mention was that a diminution of insulation had taken place in one of the three sections into which their cable was divided—the section from St. Vincent to Pernambuco. The cable, however, was working very well, and carrying all the messages they had to send. Experiments had been made, tests had been applied, and the fault had been localised to exist somewhere about thirty miles from Pernambuco, in water of not more than fourteen or fifteen fathoms. He might state, too, that though the fault was certainly within thirty miles of Pernambuco, the electricians were not at all certain that it might not be in the shore end of the cable. He need not tell gentlemen of their experience that the repair of the cable was as certain as if it lay on the floor of a room—it was a mere question of time and expense. They had sent out directions to work the cable carefully as long as it would hold. They were making arrangements to send out a ship as soon as they could to put the thing in order, and meantime they were taking their receipts and conveying their traffic just as well as before. He did not think that there was the least cause for alarm in connection with the fault. If it were in very deep water there might be, but he thought that the fact that the fault was close to land showed beyond all doubt that the deep sea section of their cable was in perfect order, and was likely to remain in perfect order. He concluded by moving the adoption of the report and the declaration of a dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year ended June 30, 1881, and a bonus of 2s. per share in respect of the profits for that year, the dividend and bonus to be paid free of income-tax.

The Vice-Chairman (Sir James Anderson) seconded the motion, which was at once unanimously adopted.

On the motion of the Chairman, seconded by the Vice-Chairman, Sir Thomas Fairbairn, Bart., was re-elected to his seat at the Board, as was also Mr. Henry Daniel Gooch, on the motion of the Chairman, seconded by Mr. Frederick Youle.

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Mr. GRIFFITH then moved the re-election of the auditors, Messrs. Henry Dever and John Gane. In submitting the resolution, he said that they must, of course, be very much indebted to the directors for securing the business which the Company had, and for the able manner in which it was conducted; but they were also very much indebted to their auditors for verifying the results of that business. As a shareholder, he must say that the accounts generally were satisfactory. They must all regret the death of one of the members of the Board, but he hoped that the directors would not be too exclusive, and confine the management of the Company to a small number.

Mr. ROUX seconded the motion, and it was carried unanimously.

Mr. KENNEDY then asked several questions, and in reply

The CHAIRMAN said that they would only lose the traffic on the one section of cable should it break down. There were three sections—one from Lisbon to Madeira, another from Madeira to St. Vincent (Cape de Verde), and the third from St. Vincent to Pernambuco. Any one of these sections might give out, but the other two would remain in full working order. Their power of carrying traffic through the whole cable would be suspended till they repaired any section which might give out, but though they would not during the interruption be earning so much, they would still earn a good deal of money, carrying part of the traffic by cable and the remainder by ship. He must respectfully decline to answer the question as to the amount to which the reserve fund would be increased. As soon as they had sufficient money at the bank to restore the whole cable, they might suspend the operation of increasing the reserve fund. The exclusive right of carrying messages by cable to Brazil was vested in this company for between eleven and twelve years more.

Mr. URWICK, in moving a vote of thanks to the chairman, directors, and officers, for the manner in which the business of the Company had been conducted, thought they must all be satisfied with the results achieved. It was very satisfactory that they had got out of the groove of 5 per cent. dividends only, and he trusted that next year the directors would see their way to make the dividend 8 per cent.

Mr. TAUNTON seconded the motion, and it was carried unanimously.

The CHAIRMAN expressed the acknowledgments of his colleagues and himself, and said that they had been very much gratified at the great unanimity shown on that occasion by the shareholders with respect to the mode in which the company was managed. They had a good substantial reserve fund at the bank, and they were able to pay a good dividend, and he hoped that that state of things would continue.

The proceedings then terminated.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).

The ninth ordinary general meeting of the members of this Company was held on the 3rd inst., at the City Terminus Hotel, under the presidency of Mr. C. W. Earle.

The SECRETARY (Mr. Constantine M. Hooper) read the notice convening the meeting and the minutes of the last meeting, which were confirmed by the present meeting and signed as correct by the chairman. The report of the directors for the half year to the 30th June was taken as read. It stated *inter alia* that the amount to credit of revenue was £41,303, which included £1,535 interest received from underwriters in respect of insurance on the ss. "Investigator." The expenses had amounted to £29,336, leaving £11,936, which, with the balance from last half year's account, made a total of £13,892, out of which it was proposed to make a payment of 3s. per share on account of arrears of dividend on the first preference shares, amounting to £5,184, and to carry the balance to currrent half year's account. The directors, from the experience they had gradually obtained, had had in contemplation the deviation of those sections of cable which have frequently failed over the same ground. Most of the necessary soundings to ascertain if safer routes could be selected had been completed by H.M.S. "Fantome," and the Company's ss. "Duchess of Marlborough." One of the most important of the deviations proposed, viz., that of the St. Thomas-St.-Kitts cable, was carried out by the Company's ss. "Grapler" in September last, with an expenditure of about 65 knots of cable. The whole of the detailed reports of soundings had not yet been received, but there was reason to hope that safer routes could in some cases be found and that the effect of the deviations would be to reduce the chances of interruption. Three hundred knots of cable had been ordered, which would be ready for despatch to the West Indies in January next.

The CHAIRMAN, in moving the adoption of the report and accounts and the dividend recommended, observed that in contrast to the very gloomy period which they had had for the last eighteen months, there was, he thought, a small ray of light upon their position that day. After a total suspension of dividend for the last twelve months they met them with the recommendation of a small payment—half the current interest on the first preference shares. At the corresponding meeting last year they could not recommend any dividend, although their accounts showed a balance of revenue over expenses of some £2,000 more than they did on the present occasion; but the position of their cables was very different then to what it was now. They then had a broken system, and they foresaw that the half year in which they met would result in a loss. They therefore advised that the directors should be allowed to retain the amount in hand, to meet the contingencies which they foresaw; and, as they had anticipated, there was a loss—a loss of about £5,000 on the second half year. The course which they adopted in not declaring a dividend on that occasion had proved to be a wise one. On the present occasion, however, there was no section of their cable interrupted. They were in communication with all their stations; and although they had two cables still requiring repair, there were duplicate cables. Both of the ships of the Company were engaged on them at that moment, and he hoped they would be put in efficient condition before long. In the meantime their revenue, such as it was, was going on fairly well, and the returns which they obtained showed, very naturally, a considerable increase over those of the corresponding period, when, as he had said, they were very much broken down. The representations which they had made at the end of last year, and the beginning of this year, to the colonies, had met with only varied success. Some of the colonies were favourably disposed, and acceeded to their application; others, on the other hand, were either unable financially to increase their subsidies, or took such an almost hostile view in their attitude towards the Company that they refused to do so. The colony of St. Thomas said, and he believed with great truth, that they could not give more, and the two French colonies—Martinique and Guadaloupe—also expressed their inability to supplement the already-granted subsidy, but, at the same time, referred the matter to their home Government. On that action of theirs the directors addressed the home Government of France, and placed before them a petition expressing their views and requirements; but at the same time they asked for an interview with the French Minister of the Colonies and Marine, which was very graciously afforded. He (the chairman) then proceeded to Paris, and the same Minister said he was favourably disposed, and in the end he said he would lay before the Assembly a project to pay the Company £4,000 a year out of the National Government funds. Whether the project whould pass the Assembly was a question. There were a great many details to be gone through before such a project could become law, and the matter would, of course, be criticised. Still, it was a hopeful feature. With regard to the action of our own colonies, as the report informed them, Lord Kimberley had advised them to hold a conference. Their experience of proposals to hold conferences was not very encouraging. Lord Carnarvon, when Colonial Minister, advised the same thing, but the colonies would not adopt his suggestion. The Governor of Barbadoes had invited the representatives of other colonies to go there, but the invitation was declined; and they did not seem to be at all unanimous in the measures they should take for considering the question. He trusted if the colonies did hold a conference that the Company would be able to have a representative present in order to state the views of the directors as to the position of the Company. There was no doubt that the colonies were very anxious to have direct lines of cable to this country; but, considering the traffic and the help which they gave to such line by direct subsidies, it seemed almost out of the question that they should be able to have their wish realised. At the same time that seemed to be their idea, and he was almost afraid that if the conference met, it might end with the idea of having direct communication with England. The Company's ships had been very constantly employed during the half year, in fact, they had only been in harbour for the time that was necessary to repair and refit their engines and other gear. The constant work which they had been able to perform had made their maintenance bill a very heavy one for the year, but it had also justified the policy of sending out the second ship. If it had not been for that second ship they would have been in the same deplorable position in which they were before she started for the West Indies. They thought that the first duty they had to discharge was to maintain the line, and if they gave a permanent and good service, as they would be able to do if their system would only keep in order, he thought it probable that a more favourable view of the Company might be taken in the West Indies. At any rate they must try and deserve that a more favourable view should be taken of their position by maintaining, to the very best of their power, the communication with those countries. He had had to appear before them now for the last eight years almost always to perform what Lord Beaconsfield had called the "dismal duty of Afghanistan," and their constant changing body of shareholders almost necessitated that he should repeat every time what was the real cause of the difficult position in which the Company was placed—namely, inadequate traffic and insufficient subsidies, those subsidies further being trammeled by conditions with which the present directors had had nothing to do. They had to supply news, and, as one of the officials in the French Colonial Office had said to him, this obligation was a sort of suicide every day. They had to give this news to the public, and it removed the necessity (which would otherwise exist) for them to telegraph and so employ the Company's lines. However, as he had said, their policy was to maintain their system, and make it as perfect as they could, and press—even importune—the colonies at every opportunity with representations of how very unfair the original terms had proved to be owing to the great miscalculation which had been made in the traffic derived from those regions. Since the issue of their report they had placed the remaining £15,000 of their debentures, and it was certainly very encouraging to notice the difference in their credit. Some years ago they had endeavoured to issue £50,000 of 7 per cent. debentures, and they could only get £10,000 placed; but this time they had been able to place the whole £50,000 at 6 per cent.

Mr. W. FORD having seconded the motion,

A discussion followed, principally on the subject of the directors' remuneration, which was maintained by Mr. Guesdon and Mr. J. Newton should be less, either by there being fewer directors, or by the directors reducing the amount received by them. Mr. Robinson Kendal also spoke of the necessity of effecting every economy. These gentlemen, however, as well as the other speakers—Mr. Goodsall, Mr. Griffith, and Mr. Sequei—all recognised the able manner in which the directors had managed the affairs of the Company, and the energy they had displayed in endeavouring to promote its welfare.

The CHAIRMAN replied, and stated that the shareholders could form no idea of the amount of work which the directors had to discharge, having to deal with thirteen different colonies, and the British, French, and Spanish home Governments.

Mr. FORD also pointed out that until the present board took office the shareholders had never received a shilling dividend; whereas they had since had £120,000 distributed among them.

Mr. GUESDON and Mr. NEWTON disclaimed any idea of hostility to the directors in what they had said, and the former gentleman wished his remarks to be considered as unsaid.

The motion was then unanimously carried, and a vote of thanks to the chairman and directors terminated the proceedings.

TRAFFIC RECEIPTS FOR OCTOBER, 1881.

COMPANIES.	Oct., 1881.	Oct., 1880.	Incrse.	Decres.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company.....	—	—	—	—
Cuba Submarine Company.....	—	—	—	—
Direct Spanish Telegraph Company	2,063	1,821	242	—
Direct United States Cable Company	—	—	—	—
Eastern Extension Telegraph Company	31,164	29,061	2,103	—
Eastern Telegraph Company	48,872	45,570	3,302	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company,.	—	—	—	—

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RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

200. TRANSFORMING, CONVEYING AND APPLYING POWER BY MEANS OF ELECTRICITY, *J. Imray.*—15*th January*, 1881.—(*A communication from M. G. E. Cabanellas.*) 1*s.*

The principal part of this invention consists in an electric cock made by having a circuit of electricity rendered uniform, and of two electric machines connected by gearing or belts, the machine with the uniform circuit being reversible. The other machine then gives out a constant amount of electricity in a given time, whatever be the local resistance or the amount locally consumed, the amount given out depending entirely on the construction of the cock and the amount of electricity supplied to it.

238. APPLIANCES FOR CONTROLLING AND REGULATING THE SPEED OF ENGINES EMPLOYED FOR DRIVING ELECTRIC MACHINES, *J. Richardson.*—22*nd January*, 1881. 8*d.*

To control and regulate the speed of the engine so as to allow of its being driven at a uniform rate of speed, the inventor fits the engine steam passage with an equilibrium throttle valve, which is acted upon by a sensitive high speed governor, and upon this governor is mounted a small dynamo-electric machine, which drives it instead of the ordinary belt gear, the dynamo machine being actuated by the same current as that which produces the light, so that its power varies in the same proportion as the intensity of the current varies. When the current generated by the machine reaches a sufficient intensity, such a speed is communicated to the governor as will at once cut off any further admission of steam, should the intensity of the current be reduced and more steam admitted. In connection with the governor is an electro-magnet which holds a weight suspended so long as the current passes, but in case of accident to the gearing, the magnet ceases to act owing to the stoppage of the current, and the descending weight shuts off all steam from the engine.

542. IMPROVEMENTS IN TELEPHONIC APPARATUS, *J. Sax.*—8*th February*, 1881. 6*d.*

This invention relates to the electro-magnetic receiving telephone as used in combination with a microphone, and refers more particularly to the mode of constructing the electro-magnets of the telephone and of connecting up the same whereby a single battery is made to serve for both telephone and microphone. In carrying out the invention the electro-magnet is enclosed in a casing provided with a vibrating iron diaghragm, but instead of using a single wire, the electro-magnet is constructed of two distinct wires, about two-thirds of each pole being coiled with wire of low resistance, and the remaining third with wire of high resistance. The continuations of these wires are then connected with a microphone induction coil and battery, so that providing the resistance of the low-resistance coils have been made as nearly as possible equal to the primary wire of the induction coil and the microphone together, the current from the battery will divide itself, one half flowing through the low resistance coils, and the other through the primary wire and microphone, so that the same battery which supplies the microphone charges the electro-magnet of the telephone.

562. CARBON BURNERS FOR INCANDESCENT CONDUCTORS, &c., *P. Jensen.*—9*th February*, 1881.—(*A communication from T. A. Edison.*) 8*d.*

To form flexible and pure carbons for incandescent lamps, the inventor takes thin sheet metal that will stand high temperatures, such as nickel or cobalt, and cuts it into the desired shape. One or several such pieces of metal are suspended in a closed flask, which is then heated to a high temperature; while in this heated condition the vapour of a volatile carbon is passed through the flask, with the result that the carbon is deposited on the metal shapes. The flask is allowed to cool when sufficient carbon has been deposited in the metal pieces; they are then taken out and immersed in some acid having an affinity for the metal used, and the metal thereby eaten away, leaving the pure carbon in the desired shape.

696. APPARATUS FOR WORKING THE BRAKES OF RAILWAY TRAINS, *C. W. Siemens and A. C. Boothby.*—17*th February*, 1881. 6*d.*

According to this invention, a dynamo-electric machine on the locomotive is connected with the coils of revolving armatures of magneto-electric or electro-magnetic machines on the brake carriages, so that the currents sent from the generator on the engine cause the armatures to revolve, and these are made to operate the brakes. The connection of the poles of the generator with the conductor is effected by a switch, so that the direction of the currents can be reversed, and the armatures made to revolve one way to apply the brakes, and the reverse way to take them off. The generator is always kept going slowly and sending a feeble current to the wires and apparatus, but not sufficient to actuate the brakes; it is also connected with a galvanometer, so that any defect may at once be indicated. The system of braking used by preference is as follows:—An extension of the axis of the revolving armature carries a worm in gear with a worm wheel on a shaft, the motion of which is imparted either by pulleys or cords to the levers that operate the brake blocks, the arrangement being such that when the worms on the armature axes are rotated one way, they turn the worm wheel and shaft and apply the brake; contrarywise they take it off.

715. ELECTRIC LAMPS, &c., *J. G. Tongue.*—18*th February*, 1881.—(*A communication from Dr. A. Lacombe.*)—(*Not proceeded with.*) 2*d.*

This invention has for its object improvements in and connected with electric lamps, and also for other lighting and heating purposes, and consists of mounting two or more pairs of carbons on an axis, so that after a definite time has elapsed, of a duration nearly equal to the time the carbons will last, the axis and connections receive a partial rotation by means of a current attracting an armature or other device. The inventor also surrounds the negative carbon with a carbon tube insulated from each other.

732. A MAGNETIC FIRE ANNIHILATOR, *W. Walker.*—21*st February*, 1881. 4*d.*

This invention relates to the extinguishing of fires by the use of water that has been acted on by a magnet. Magnets are fixed in a vessel containing the water to be used, and it is then forced through a delivery pipe. The apparatus may be attached to a fire-engine, or to any ordinary service of water. On the water coming into contact with the fire it becomes decomposed (the oxygen and hydrogen contained in it being separated). The carbon arising from the burnt *débris* immediately combines with the oxygen. Carbonic oxide and carbonic acid gas are thus generated, which put out the fire.

733. IMPROVEMENTS IN STEAM GAUGES, &c., FOR PRODUCING SIGNALS WHEN THEIR INDICES SHOW A PRESSURE, &c., EXCEEDING THE LIMITS FOR WHICH THEY ARE ADJUSTED, *W. R. Oswald.*—21*st February*, 1881. 6*d.*

In this invention contact pieces, connected by a battery, are provided in connection with the gauges, and are so arranged that when the index finger of the gauge comes in contact with either of the terminals an electric circuit is completed or broken, and a bell or other audible or visible signal is actuated, so that it can be told at a glance whether too much pressure or too low a vacuum is the cause of the signal.

785. IMPROVED METHOD OF COVERING WIRE FOR ELECTRICAL PURPOSES, &c., *W. E. Ayrton.*—24*th February*, 1881. 4*d.*

The invention relates to the covering of three or more conductors arranged in a parallel direction by weaving them together with a weft of silk or other insulating material; also the use of the wire or wires as a weft to weave together a number of fibres of silk or other insulating material which forms the warp. This method ensures the easy recognition of any individual wire at any point by its distinctive position in the web, provides a certain means of destroying mutual induction, and a simple method of constructing a coil of a single continuous conductor which has no external magnetic action nor self-induction.

792. IMPROVEMENTS IN ELECTRIC LAMPS, AND IN CIRCUITS FOR THE SAME, *P. Jensen.*—24*th February*, 1881.—(*A communication from T. A. Edison.*) 6*d.*

The object of this invention is to furnish a method of connecting in one multiple arc a series of lamps, each giving the same amount of light as the standard light of the system, so that all the lamps in such circuit may be controlled by one circuit closer. The general idea of the invention is to make the density of the carbons where a series of lamps are used proportionately greater than that of the standard lamp, their conductivity increasing and resistance decreasing proportionately, so that with the standard amount of energy and the standard amount of electromotive force each lamp of such series shall give the standard amount of light, the radiating surfaces of each remaining approximately at the area of the radiating surface of the standard lamp. The proportions in which the density, &c., of the lamps must be increased and diminished may be expressed approximately by a fraction whose numerator is 1, and the denominator the square of the number desired to be so connected.

879. IMPROVEMENTS IN ELECTRIC LIGHT SIGNALLING AND MEANS OR APPARATUS CONNECTED THEREWITH, *A. Shippey.* 1*st March*, 1881. 4*d.*

In carrying out this invention the inventor makes use of a balloon, to which are attached an apparatus for providing electric light, and also for the periodical discharge of rockets, &c., which balloon and apparatus are connected by a conducting wire with the ship, on which is the battery or generator, and also by another wire with a float in the sea, which is used as the return wire.

1232. ELECTRIC LAMPS, *H. E. M. D. C. Upton.*—21*st March*, 1881.—(*Not proceeded with.*) 2*d.*

This invention relates to regulating the carbons of a lamp. For this purpose the inventor rests the end of a vertical carbon upon two studs, which are the terminals of the conducting wires, the carbon bearing on these studs by its own weight, and sinking downwards as its lower portion is consumed.

1726. IMPROVEMENTS IN ELECTRICAL CALL OR SIGNAL APPARATUS, *W. R. Lake.*—20*th April*, 1881.—(*A communication from H. D. Rice and J. B. Currier.*) 8*d.*

The first part of the invention relates to a device for giving alarm at any desired station in a circuit without sounding an alarm at any other station. To accomplish this the inventor makes use of vibrating springs, which are graduated so as to vibrate at given normal rates of oscillation, and an undulatory electric current synchronous with the spring to be actuated, each spring on a circuit being different from the other, and each operating on a bell. This enables the placing of a number of alarms on the same circuit all operated at a different speed of vibration. In connection with the vibrating spring is a cylinder, which winds or unwinds the spring on itself, thus admitting of the adjustment of the spring to the varied number of vibrations. The second part of the invention consists of a switch which shifts, if required, the current from the main circuit to the short circuit of any station, when it is desired to call this station only. These switches act in synchronism with the vibrating tongues at the different stations.

2256. SUPPORTING STRUCTURES FOR ELECTRIC WIRES OR CONDUCTORS, *W. R. Lake.*—24*th May*, 1881.—(*A communication from W. C. Allison.*)—(*Complete.*) 6*d.*

This consists either of an arch or girder spanning the street or of two arches or girders sprung diagonally from one corner to another, and intersecting each other in the middle, from which an electric lamp is hung, the arches in both cases being provided with insulated supports for the electric wires.

2593. IMPROVEMENTS IN ELECTRIC CLOCKS, *A. M. Clark.*—14*th June*, 1881.—(*A communication from J. Schweizer.*) 6*d.*

In this clock the barrel is dispensed with, and two wheels are employed, of which one is fixed on the arbor of the minute hand and drives the motion work which moves the hour hand. The other drives the pinion on the escapement wheel abor. Thus the power is applied directly to the centre wheel. A ratchet wheel having fine teeth rides loose on the same arbor as the first wheel mentioned above. This wheel is rotated by the gravity of a weight, which is raised again when it has fallen to its lowest point by electrical action, the ratchet wheel in the meantime, whilst the weight is being lifted, being turned by the stress of a spring. The specification describes at length the means of determining with precision the closing and breaking of the electric circuit in connection with the lifting of the weight.

246,218. TELEPHONE CENTRAL OFFICE APPARATUS, *William H. Sawyer, Providence, R.I.*—*Filed June 21st*, 1881.

Brief.—Communication between different switch boards at a central office is effected by means of balls, upon which the required information is written, the balls being then conveyed to the desired table through a tube.

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CRYSTAL PALACE.

AN INTERNATIONAL ELECTRIC EXHIBITION

WILL BE OPENED IN THE CRYSTAL PALACE, SYDENHAM, IN DECEMBER, 1881,

AND CONTINUED FOR SOME MONTHS.

THE PRINCIPAL OBJECTS TO BE ADMITTED ARE COMPRISED IN THE FOLLOWING :—

a. Apparatus used for the production and transmission of electricity.

b. Magnets, natural and artificial. Mariners' Compasses.

c. Applications of electricity—to telegraphy and the transmission of sounds; to the production of heat; to lighting and the production of light; to the service of lighthouses and signals; to apparatus giving warning; to mines, railways, and navigation; to military art; to fine arts; to galvano-plastic, electro-chemistry, and to chemical arts; to the production and transmission of motive power; to mechanical arts and horology; to medicine and surgery; to astronomy, meteorology, geodesy; to agriculture—in its application to industries; to apparatus for registering; to domestic uses; lightning conductors.

Printed Forms of Application for admission (which should be made at once) can be had from the Manager, Crystal Palace, Sydenham, S.E.

CRYSTAL PALACE.—INTERNATIONAL ELECTRIC EXHIBITION.

APPLICATIONS for the remaining SPACE will be received up to and including MONDAY, Nov. 14.

Address MANAGER, CRYSTAL PALACE, S.E.

THE EXCHANGE TELEGRAPH COMPANY, LIMITED.

Head Offices—17 & 18, Cornhill, E.C.; Stock Exchange, E.C.; 27, Regent Street, W.

Incorporated the 28th March, 1872, under the Companies Acts of 1862 and 1867, and by Special License from H.M. Postmaster-General.

This Company will undertake to supply recording instruments, telegraphically connected with the Stock Exchange, by the aid of which Subscribers, at their respective offices, may be kept continuously advised throughout the day of the constantly occurring market fluctuations in stocks and shares.

Instruments are placed in the offices of Subscribers and kept in order by the Company, free of every expense but that of rent, and inspectors visit them daily to supply ink and paper.

Terms: £50 per annum, payable quarterly in advance.

Applications for instruments to be made to the Secretary at the above address.

The Company is prepared to treat with provincial Companies requiring instruments for the delivery of news for either single or double wire systems under the Company's patents, whereby from central stations identical information can be simultaneously delivered to any number of recipients by automatic, self-adjusting, printing instruments requiring no local batteries, no winding up, and no knowledge of telegraphy on the part of the receiver, the printing being in bold roman type, and the propulsion of the paper being effected by the electricity supplied from the Central Office.

Not having any springs or clockwork to wind up or to depend on, these instruments are acknowledged by those familiar with the system of telegraphy to be the only instruments yet invented that are capable of doing the work required of them continuously for a lengthened period, as evidenced by the fact that the Gold and Stock Company of New York, having the monopoly of this kind of business in the States, and which owns all the patents of the day of any value, has, after due trial, discarded all others.

The instruments supplied by the Company can be had to work either on single or double wires, and to print either on a slip or tape of paper, as has hitherto been the custom, or on a broad band of paper in column form.

The system has been in use by the Exchange Telegraph Company (Limited) in the City and West End of London since 1872, and by MacMahon's Telegraphic News Company (Limited), for the delivery of Parliamentary, Sporting, and General Intelligence, since 1879.

The Company will supply householders and others with its

DISTRICT CALL SYSTEM.

By the aid of a small automatic telegraph instrument a Subscriber can at any hour, day or night, call a messenger, cab, or policeman, or give the alarm of fire, and will obtain the required assistance within three minutes of making the signal. Subscribers, when absent from their homes for a season, can leave their houses closed, and have them taken charge of by the Company, and rendered perfectly secure against burglars by a telegraphic communication with the nearest District Call Station of the Company, where a policeman will always be in readiness day and night to respond to calls.

Provincial combinations to work under the Company's Patents will be treated liberally.

The Company is also prepared to supply Municipalities with its system of

STREET FIRE ALARMS,

as recommended by H. M. Postal Telegraph Department to the Metropolitan Board of Works for the Metropolitan Fire Brigade, and which has received favourable mention by Captain Shaw in his last annual report.

These Alarms have recently been considerably improved by the Company, and are acknowledged to be the simplest yet constructed.

All communications to be addressed to the Secretary as above.

THE SCHOOL OF SUBMARINE TELEGRAPHY & OF TELEPHONY.

ESTABLISHED IN 1868.

4, GEORGE STREET, HANOVER SQUARE, LONDON, W.

MANAGING DIRECTOR: Mr. T. J. JONES, M.S.T.E.

The course of Practical and Theoretical Instruction in the higher branches of Overland and Submarine Telegraphy embraces, in addition to the manipulation of the various systems of working in general use, the following subjects :—

MATHEMATICS, MECHANICS, and CHEMISTRY, } In relation to Telegraphy.

- SIGNALLING and TESTING INSTRUMENTS.
- ENGINEERING FORMULÆ and their Application in Practice.
- ELECTRO-STATICS.
- ELECTRO-DYNAMICS.
- MAGNETISM.
- METHODS of TESTING the ELECTRICAL CONDITION of a LINE During and After its Construction.
- TESTING FOR and LOCALISING FAULTS, &c., &c., &c.

The instruction, both in signalling and testing, is of a thoroughly practical character, as the classes work with the actual instruments used on long lines, through cables of various lengths, from 600 to 3,000 knots, so that the signals of the Eastern, Atlantic, and Brazilian Co.'s, &c., are exactly reproduced, and the pupils fitted for any line.

A Course of Instruction in the Fitting up, working, and Testing of TELEPHONE CIRCUITS has now been added to, and embodied in, the ordinary curriculum, including all the forms of TELEPHONES, the various switch board arrangements and EXCHANGE SYSTEMS in general use.

Further information can be obtained on application to the SECRETARY.

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BONDED STORE AND PROVISION MERCHANTS,

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Special Arrangements made for Supply of Goods to Telegraph Stations.

D. W. & Co. have supplied Provisions to the Stations of the Eastern and South African Telegraph Companies, and are prepared to execute orders on specially favourable terms at shortest notice.

TO ELECTRICAL ENGINEERS and EXPERIMENTALISTS.—WATCHES which CANNOT be "MAGNETISED," as exhibited at the Electrical Exhibition, Paris.

E. DENT and Co. (makers of the standard clock of the Royal Observatory, Greenwich), 61, Strand, and 34, Royal Exchange, London (only addresses).

N.B.—Watches can be converted to this plan.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

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Specialities—Morse Instruments, Type Printers, Cable Relays and Keys, DUPLEX, Quadruplex, & Translating Apparatus, P.O. Pattern.
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Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

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Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

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Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

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This standard work contains all legal and other information necessary for intending patentees, including Government charges, agency fees, and rules of the Commissioners of Patents.
TRUBNER and Co., Ludgate-hill, and may be obtained at the Office for Patents, 66, Chancery-lane, W.C.

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HARBURG INDIA-RUBBER COMB COMPANY.
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REQUIRED, to HIRE or PURCHASE, a D 2 SIEMENS DYNAMO MACHINE. Address X. B., care of Steel and Jones, Advertising Agents, Spring-gardens, S.W.

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IN COMBINATION WITH
BELL'S EBONITE TELEPHONE.
Unequalled for Telephone Exchange or Private purposes.
ALL ROYALTIES PAID.
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Capital £800,000; First Issue £400,000.
VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation are willing to receive applications for licences or concessions for defined districts, counties, or towns in the United Kingdom.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

The Corporation is also prepared to supply for domestic lighting, incandescent lamps of 10-candle power and upwards, manufactured with the newest improvements, under the "Lane-Fox" system. These lights are suitable for private houses, business offices, clubs, hotels, &c.

Concessions for the colonies and for foreign countries of the valuable patent rights under both of these systems, including methods of manufacture, regulation, and distribution, can be negotiated with the Corporation.

All inquiries to be addressed to the Secretary, at the offices, Belvedere-road, Lambeth, S.E.

HARBOROW & CO.,
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Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
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31st March, 1880.

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As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.
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SLIP

THE TELEPHONE IN SHANGHAI.—The telephone is said to be much used in this city.

ROYAL SOCIETY.—The anniversary meeting of this society will be held on the 30th inst.

ELECTRIC LIGHT IN THE EGYPTIAN HALL.—We hear that the electric light is to be introduced into the Egyptian Hall, Piccadilly.

ELECTRIC LIGHT FOR KIMBERLEY, NATAL.—A Reuter's telegram says that Kimberley is to be lighted with the electric light.

ELECTRIC LIGHT IN COLLIERIES.—It is stated that trial is to be made of the electric light at the Mardy Colliery, South Wales.

ELECTRIC LIGHTING IN LIVERPOOL.—The Corporation have agreed to allow the British Electric Light Company to carry their wires underground.

ELECTRIC LIGHT AND THE CZAR.—It is stated that the Czar of Russia employs the electric light in his palace at Gatschina, sixteen lamps being used.

ELECTRIC LIGHT AT CAPE TOWN.—It is stated that the railway station has been lighted by electric light as an experiment, and that it is likely to be adopted.

THE TELEPHONE IN SCOTLAND.—It is the intention of the National Telephone Company of Scotland to establish an exchange at Helensburgh, a fashionable Clyde watering place.

ELECTRIC LIGHT FOR CASTLEFORD.—It is stated that the Castleford Local Board are thinking of introducing the electric light into that town, though no positive decision has yet been arrived at.

ELECTRIC LIGHT IN THE OPERA HOUSE, PARIS.—Further experiments in lighting the Opera House by electric light have taken place, no gas at all being used. The incandescent lights are said to have been very successful.

THE TELEPHONE AT BRIDPORT.—The telephone seems to be making way in the provinces. We hear that a firm at Bridport have adopted it, the line having been erected by the United Telephone Company's Bristol Exchange.

ELECTRIC LIGHT FOR DUNDEE.—The Town Council of Dundee are going to apply to Parliament during the next session for the necessary powers to introduce the electric light into that town should they ever think fit to do so.

ELECTRIC LIGHT FOR ABERYSTWITH.—There is every probability that the Brush light will be introduced into this town soon. The matter is under the consideration of the Town Council, and we believe they are in negotiation with Messrs. Hammond and Co.

ELECTRIC LIGHT FOR FULHAM.—With reference to our note of last week, reporting that tenders had been invited by the Fulham District Board of Works for lighting parts of their district by electric light, we believe that nothing has as yet been done in the matter.

THE TELEPHONE IN LISBON.—Notice has been given that the term for receiving tenders for telephonic communication in Portugal has been extended to the 8th December. Specifications and conditions of tendering can be seen at the Portuguese Consulate-General in London.

BRITISH ASSOCIATION.—It is stated that the local subscriptions to the jubilee meeting of the British Association, recently held at York, amounted to £2,799, the number of visitors to the meeting being 2,557. It has been resolved to return a sum equal to 5 per cent. to the local subscribers.

NORTHERN ELECTRIC LIGHT, POWER, &c., COMPANY.—This is the title of a company which has been lately incorporated, with its head-quarters in Dundee. The capital is £100,000, in £1 shares; first issue 10,000 shares, payable on allotment at the rate of five shillings per share. Mr. G. Lowdon, of Dundee, is electrician to the company.

THE TELEPHONE IN MELBOURNE.—The *Colonies and India* says that attempts have been made to establish telephonic communication between Sydney and Melbourne. The wires were not specially prepared, and only faint sounds could be heard over the entire line; but from Melbourne to Albany (some 200 miles) voices were perfectly audible.

THE TELEPHONE IN INDIA.—With reference to our note of last week, saying that the Government had granted a license to the Oriental Telephone Company to commence work in Bombay, the *Homeward Mail* says that a large number of subscribers have been registered already, so the first telephone exchange in India will have a fair trial.

ELECTRIC LIGHT AT GLASGOW.—It is stated that the galleries of the Glasgow Fine Art Institute are to be fitted up with incandescent lamps, whilst the front of the building will be lighted by means of arc lights. The electric lights in the *Glasgow Herald* office, which were dispensed with some little time ago, have been reinstated, and are in regular work now.

TRANSMISSION OF MONEY BY TELEGRAPH.—A correspondent suggests that facilities be given by the Postmaster-General for the transmission of money by telegraph. He says the system has been in use for many years in New Zealand and in some parts of the Continent, and has been found to work well. Our correspondent asks, "Why should not we imitate our enterising colony?"

TELEGRAPHS IN CHINA.—It is stated that the erection of a telegraph line between Soochow and Shanghai is being vehemently opposed by Chinese agriculturists, who are placing all manner of obstacles in the way of the workmen. They pull up and destroy the poles, thinking that they are prejudicial to farming operations. Troops have, it is said, been despatched to protect the line.

TELEGRAPH STORES WANTED.—The Midland Railway Company are inviting tenders for the supply of telegraph instruments, wire, bolts, insulators, shackles, &c., also india rubber. Patterns can be seen at the General Stores Department, Derby, and forms of tender may be had on application to Mr. Pettifer. Tenders are to be addressed to the Secretary, General Stores Committee, Midland Railway, Derby, and must be received by 12 noon on the 14th instant.

SS. "FARADAY."—Last week we noticed the arrival of this cable ship in the Thames, after having successfully laid the deep-sea portion of the second of the new Atlantic cables. The work was achieved in the face of the recent terrific gales, and it speaks well for the sea-going qualities of the vessel, and for the pluck of her commander, crew, and electrical staff, that the work should have been carried out under such difficulties. The "Faraday" will leave again in a few days to repair the first cable.

PRICES.—The prices as quoted are:—For gutta percha, per lb., good to fine, 1s. 8d to 3s. 6d.; low to medium, 3d. to 1s. 7d., being exactly one penny per lb. less than the prices ruling at same date last year. For India rubber, fine Para, 3s. 6d.; negrohead, 2s. 2d. to 2s. 3d.; central American, 1s. 7d. to 2s. 4d; Assam and Pegu, 8d. to 2s. 1d.; other East Indian, 1s. 3d. to 2s.; Madagascar and Mozambique, 1s. 9d. to 2s. 3½d. These prices are all less than those ruling last year, fine Para being 3½d. per lb. cheaper.

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EDISON'S LAMPS FOR THE CITY.—At a meeting of the Commissioners of Sewers, held this week, a proposal was made by Mr. E. H. Johnson, Mr. Edison's agent in England, to light with Edison's incandescent lamps the Holborn Viaduct as far as the subway extends, free of cost, for two months. This was referred to the Streets Committee to consider and report. We believe it is also Mr. Edison's intention to establish a central station from which to supply light to houses within a convenient distance round the viaduct.

INDIAN TELEGRAPH DEPARTMENT.—The Secretary of State for India will offer two appointments in the Indian Telegraph Department to students entering the Royal Engineering College, at Cooper's Hill, Staines, in September, 1882, after two years' course of study, that is, in the summer of 1884. Students must on the 1st July, 1882, be over seventeen and under twenty-one years old. Further particulars can be had, by letter only, of the secretary, Public Works Department, India Office, S.W.; or of the president, at the college.

INSTITUTION OF CIVIL ENGINEERS.—The council of this institution are inviting communications on various subjects relating to engineering work. For approved original communications the council will award certain premiums. Amongst the subjects those referring to electricity are:—Mechanical power on tramways, including steam, compressed air, electricity, &c.; magneto and dynamo-electric machines, with their relative advantages; the generation, storage, and transmission of electric energy, the purposes to which it may be applied, and the sources of loss.

SS. "INTERNATIONAL."—The ss. "International," belonging to the India Rubber, Gutta Percha, &c., Works Company, of Silvertown, sailed for Vera Cruz on Wednesday last. She carries the Atlantic portion of the Central and South American Cables. On her way out she will touch at Kingston, Jamaica, for coals and provisions. The section she has to lay is a heavy-type shallow-water cable to connect Vera Cruz with Goatyacoalcos, the port on the Gulf of Mexico side of the Isthmus of Tehuantepec. The engineer and general manager of this Company is Mr. Joseph Barker Stearns, of duplex fame.

SOCIETY OF ARTS.—Last week we gave a list of papers to be read during the coming session of this society. The dates of some of these have now been announced, as follow:—On the 23rd of November, Professor Sylvanus Thomson will read his paper on "The Storage of Electricity;" on the 30th, a discussion on the society's Patent Bill will be opened by Sir Frederick Bramwell, F.R.S.; on the 14th of December, Mr. Preece, F.R.S., will read a paper on "Electric Lighting at the Paris Electrical Exhibition;" and the same gentleman will give two juvenile lectures on Wednesday evenings, the 28th December and 4th January, on "Recent Wonders of Electricity."

THE ACTINIC BALANCE.—Speaking of Professor Langley's Bolometer, or Actinic Balance, Professor S. P. Thomson says, in *Nature*, of the 3rd November:—"It may be pointed out that the fundamental principle of the bolometer is identical with that of Siemens' Electrical Pyrometer, where also changes of temperature are measured by changes in the electric resistance of a conductor. But though the principle be identical the application is quite novel, and we must congratulate Professor Langley on the skill and ingenuity with which he has applied an unpromising principle to the construction of this most interesting and most promising instrument of research." Siemens' Electrical Pyrometer was described in *The Electrician*, Vol. VII., p. 221.

ELECTRIC LIGHTING.—Lectures on electric lighting are becoming quite the fashion now. We notice that the Menai Society of Natural Science and Literature, whose headquarters are at Bangor, North Wales, were recently entertained by a lecture from Captain E. H. Verney, R.N., "On the Electric Light." Captain Verney began by explaining the modes of producing electricity, and afterwards described the various arc and incandescent lamps, one of the latter being lighted up. Faure's accumulator and the telephone were also described. Various experiments, illustrating the action of the current in batteries, electro-magnets, &c., were shown. At the conclusion of his paper a cordial vote of thanks was tendered to Captain Verney by his audience. The various apparatus was lent for the occasion by Mr. Paterson, of Little Britain, E.C.

PHOTOMETRY.—The committee on photometric standards have presented their report to the Board of Trade. They find that the method of taking the average of three consecutive candle determinations to indicate the illuminating power of coal gas does not yield satisfactory results. After a series of experiments with various photometric standards submitted to them, the committee recommend the adoption of Mr. A. G. Vernon Harcourt's air-gas flame, in which the combustible gas is a definite mixture, prepared by the operator, of air and the vapour of light petroleum. The gas is burnt at a definite rate from a $\frac{1}{4}$-inch orifice in a brass burner and the height of the flame is adjusted to $2\frac{1}{2}$ inches. At the same time they recommend that in official documents the quality of light furnished by coal gas as shown by Mr. Harcourt's lamp should be expressed as heretofore in standard candles.

INTERNATIONAL ELECTRICAL EXHIBITION AT PARIS.—The Paris correspondent of the *Standard* of the 9th November says:—"M. Cochery, the Minister of Posts and Telegraphs, has laid upon the table of the Chamber of Deputies his measure for empowering the Government, on the occasion of the Electrical Exhibition, to make nominations and promotions in the Order of the Legion of Honour beyond the restrictions imposed by the law of 25th July, 1873. The same are not to exceed four Commander's Crosses, eight Officer's Crosses, and thirty Knight's Crosses. In justification of his proposal M. Cochery, dwelling upon the important results of the Exhibition for the future of electrical science, remarks that it is only just to convey to those exhibitors, members of the Congress and co-operators of every class, by whose efforts and devotion success has been achieved, a testimony of national gratitude.

A SPECIAL CORRESPONDENT ENLIGHTENED.—We read in the *Daily News* of the 5th instant:—"Extensive preparations have been made for telegraphing the reports of the Lefroy trial as it proceeds. With the aid of some of the Royal Engineers, posts have been erected and telegraph wires suspended from the London, Chatham, and Dover Railway Station right up to the court itself, where, in a corner of the vestibule, the instruments are placed, and a staff of operators are already at work. The last wire was fixed this morning by a private of the Engineers, whose extraordinary celerity in ascending and descending a telegraph post seemed unaccountable until a closer inspection of the soldier's equipment explained the mystery; each of his legs was encased in a light iron legging, which bore at the ankle a sharp steel spike. There is no comparison more appropriate to this device than that of the spur of a cock. Thus provided the soldier clambered up the perpendicular post with apparently as much ease as a monkey climbing a pole, and remained perched at the top, while he made fast the wire, with the spikes on his feet fixed firmly in the wood." N.B.—It is only

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necessary to observe that there is scarcely a telegraphic lineman in Europe and America who does not daily do the same thing.

National Telephone Company.—We have received a neatly got up "Directory of Subscribers to the Glasgow District Exchange" of this company, dated October last. From the preface to this directory, which is the first that has been issued, it appears that the first telephone was placed in Glasgow about October, 1879, and there are now in operation close on 500 exchange and 200 private lines. Until lately the operations were greatly hampered by rival companies, but now the interests in the city have all been amalgamated and are controlled by the present company. An exchange is shortly to be opened in the west end of Glasgow, which is intended for the use of private houses, and which will be in connection with the theatres, fire and police stations, and other public buildings. It is also hoped that the principal shops will be connected with it. The subscription to this exchange will be £15 per annum for a half-mile radius, or £10 if the subscriber be a member of a firm already in connection with any of the other exchanges. Subscribers can also be connected direct with the Post Office for the purpose of sending telegrams for an extra rental of £5 5s. per annum. The directory contains an alphabetical and a classified list of subscribers. By means of the latter one can tell at a glance what doctors, hotels, contractors, &c., &c., are connected with the exchange. It also contains instructions for using the telephone, is well printed, and neatly got up. The company have now some sixty or seventy of their subscribers on the "Law" system, *i.e.*, where a *calling wire* loop is employed, and no local battery or magneto generator for ringing is required at the subscriber's station.

Lord Crawford on Electricity.—At a recent distribution of prizes to the students of the Wigan Mining and Mechanical School at which Lord Crawford was present, his lordship made some remarks on electricity and its applications which we reproduce. After alluding to his visit to Paris as the representative of Her Majesty's Government, and having given a brief *résumé* of the historical apparatus there exhibited, he said that he had seen in the papers the other day that a very distinguished engineer, in addressing a meeting, said that within a few years there would be as great a change in mechanics and the transmission of power as there was between horse-power and the introduction of steam. He could not say that he entirely agreed with that. He did not think they were going to see steam displaced by electricity, because, in the first place, they required the means to produce their electricity. It was easy to say they had their electricity always at hand and that they were going to do everything with it, but they first required a force to produce it, and electricity was merely a means of transmitting to an end. He did not think that the electric light in its present state would do anything to do away with the trade of Lancashire or their own particular district in the way of reducing the consumption of gas. But he must admit that at first, when he saw all the new methods in operation—the methods of lighting rooms, factories, large buildings, &c.—he had a sort of impression that there might be something unwise in keeping on as a coalowner; however, the more he saw of it the more he felt the impracticability of using the light universally—first, because of the expense of producing it; secondly, the expense of keeping it up; and thirdly, the danger of placing it in the hands of ignorant men and the danger of working it. There were, however, many things in which he thought the employment of electricity would be of very great service, say, for instance, where large areas had to be lighted—no amount of gas could there stand against the electric light. At the present time they were using it at the docks, and the dockyard labourers were enabled to go on with their work in the night, thus working double shifts and saving time, labour, and expense to the shipowners. There was another reason why gas would not go down in consequence of the introduction of electricity, and that was that the burning of gas was the cheapest way of producing electricity. He could explain the matter in this way: If they would take a quantity of gas equal in illuminating power to 172 candles, that same amount of gas utilised by passing it through a gas engine for the purpose of driving a dynamo-electric machine would produce a light equivalent to about 1,000 candles. There they had with gas burned in the ordinary manner a light equal to 172 candles, while if the heating power were used instead of the lighting power, it would give a light equal to 1,000 candles. There was no doubt a great future for the electric light.

Central and South American Telegraph Company.—The report of this company states that contracts have been concluded for 3,082 nautical miles of submarine cable of various types, with the India Rubber, Gutta Percha and Telegraph Works Company (Limited), of London. The latter company is to lay and guarantee the perfect working of these cables as a whole, and is required to guarantee that the various types of cable shall be of sufficient length, respectively, to properly connect the points required. Twenty-two miles of cable are being completed daily, and it is reported by the company's electrician to be of very superior quality. The provisions of the contract amply secure the company in every particular against loss, damage, or delay. No less than five steamers will be necessary to transport the cable and its accompanying material. The first shipment will clear from London Nov. 15, or pay a penalty of 1,000 dollars per day for each day's delay; the other shipments will follow at fixed dates under heavy penalties for delay. The cable connecting Panama with Callao is to be completed by May, 1882, and it is expected that the whole line will be in commercial operation during the ensuing month of July. Careful estimates of cost have been made, and it is expected the company will have an ample cash surplus and 1,000,000 dols., par value, of its stock in its treasury on closing the construction account. This result will be attained notwithstanding the fact that the company will have about 900 tons of cable more than the original estimates called for, and that it has secured the following valuable exclusive telegraphic rights not included in the original prospectus:—United States of Colombia, the exclusive right covering its Pacific coast, inclusive of the Isthmus of Panama, for twenty-five years; Ecuador, the exclusive right for fifty years, and Peru, the exclusive right for twenty-five years. All of these rights have been ratified and confirmed by the respective governments, and contain other privileges highly beneficial to the company. J. B. Stearns, who has been appointed electrician and general manager of the company, has secured an experienced staff of electricians to watch over the cable in every stage of its manufacture and laying. The establishment of these cables will connect, telegraphically, the United States with Brazil, via Mexico, Guatemala, Costa Rica, Panama, Colombia, Ecuador, Peru, Bolivia, Chili, and the Argentine Republic; and their geographical position is such as will insure a large and remunerative traffic from the time of opening. [We recently gave the names of the vessels and of the electrical staff that will proceed to lay the above cable. See *The Electrician*, Vol. VII., pp. 370, 371.]

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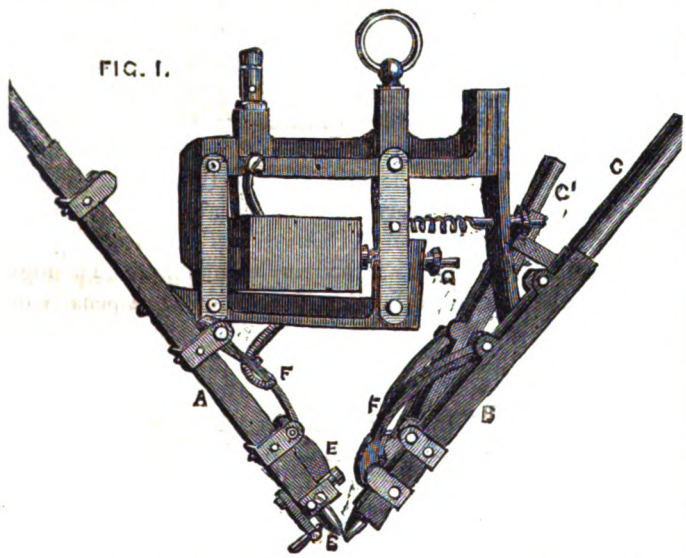
THE ELECTRICAL EXHIBITION AT PARIS.

Hedges' Electric Lamps.

Mr. Killingworth Hedges exhibits his arc lamp, which differs somewhat from others of the same kind in the method adopted to regulate the movement of the carbons. We illustrate one form of the lamp in Fig. 1. The carbons are contained in the two rectangular troughs A and B, which approach each other as shown; the two carbons are of circular section, and free to slide downwards to the point E, where they meet when no current is passing. The trough B, in which the positive carbon slides, is fixed, but trough A, containing the negative carbon, is permitted to rock by the pivot which attaches it to the framework of the lamp, and is controlled by the armature of an electro-magnet, which regulates its position. When the armature is attracted the carbon is withdrawn and the arc established. The length of the arc is regulated by the screw G, which regulates the movement of the armature. C^1 is a small carbon rod sliding in the trough shown, and which by pressing gently against the carbon B prevents the latter from slipping, and so regulates its consumption. C^1 is slowly consumed as B is used up. The negative carbon is held in place by a small adjustable platinum stop, E, which presses against its conical end and prevents its slipping except as the cone is consumed during the production of the arc. The position of E is regulated

FIG. 1.

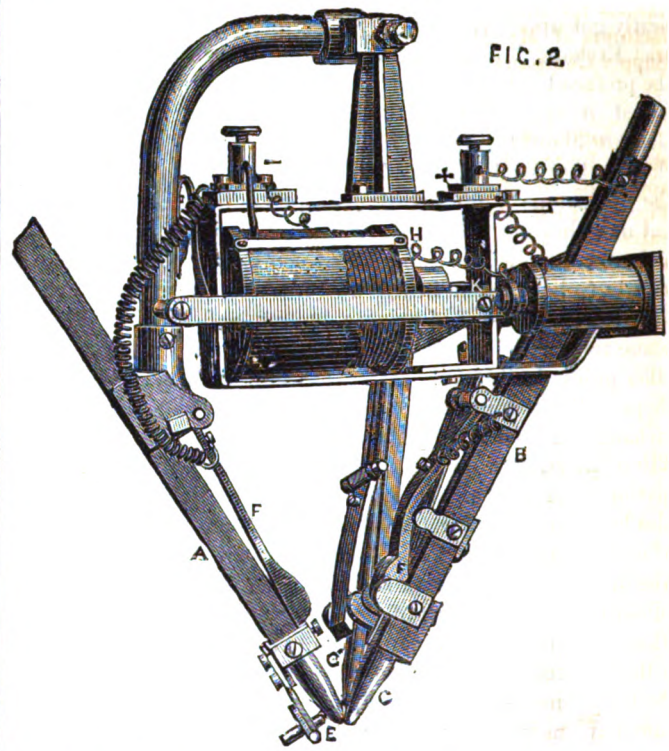


by the small adjusting screw shown. In order to obtain good contact between the conductors and the carbons a contact piece, F, is provided, fitted at its lower end with a block of brass grooved so as to fit the carbon rod, and pressing against it. By this means the resistance of the carbons is always the same, as the shortening of their length by combustion is of no consequence since the contact pieces press against their lower ends, and the resistance is reduced to a minimum.

A modification of the above described lamp is shown in Fig. 2, in which the arrangement for separating the carbons to form the arc is somewhat different. This kind of lamp is designed for use when it is required to connect up a number of lights in series. The arc is formed by separating the carbons through the attraction of an iron plunger, to which is attached the armature of the electro-magnet, by a solenoid, the fine wire coils of the magnet forming a shunt circuit between the two terminals of the lamp. Thus when the circuit is completed and the arc formed, the distance between the carbons is adjusted according to the respective influences of the solenoid and the electro-magnet on the armature. Should, therefore, the arc become too long, and the resistance thereby be increased, a larger amount of the current will flow through the coils of the electro-magnet, which will have the greatest influence on the armature, and this in turn will reduce the distance between the carbons.

Fig. 3 shows the shape of the three carbons used in Mr. Hedges' lamp after they have been burning with an M Gramme machine running at 1,300 revolutions. The negative carbon marked — (A in Figs. 1 and 2) burns 1 3-16 inch per hour; the positive carbon, marked + (C in Figs. 1 and 2) burns $2\frac{3}{8}$ inches per hour. The figure also gives an end

FIG. 2.



view of the positive and the supporting carbon (marked C' in Figs. 1 and 2). This latter burns 5-16 inch per hour.

Mr. Hedges has also designed a two-way switch to prevent

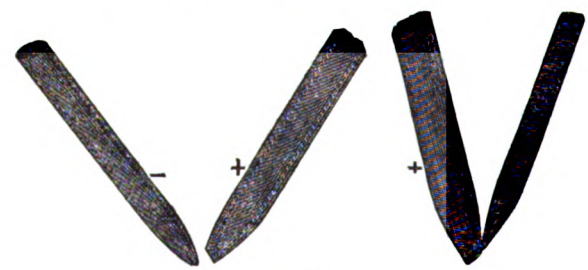
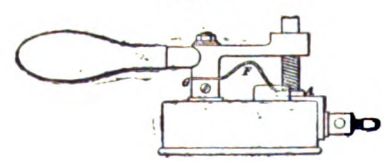


FIG. 3.

the sparks which occur in the ordinary kinds in use. We illustrate this in Figs. 4 and 5. The switch is provided with a circular contact piece (Fig. 5), which can be turned

FIG. 4.



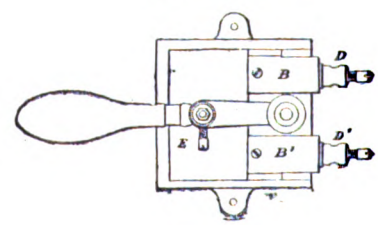


FIG. 5.

round if required when one surface has become worn. The space between the two fixed contact pieces B, B' is filled up with a block of compressed asbestos, the surface of which is flush with the upper surfaces of these two

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contact pieces. Good contact with these latter is insured by means of the spiral spring A (Fig. 4). To prevent dust collecting in the joint, connection between the fulcrum G of the switch lever and the circular contact piece is made by means of the bent spring F (Fig. 4). E, D, and D′ are the various terminals for the attachment of wires. The manufacturers of Mr. Hedge's exhibits are the Electric Lighting Supply Company, of Queen Ann's-gate, Westminster.

Napoli's Electric Regulator.

An ingenious little apparatus, devised by M. Napoli, is shown by the Eastern Railway Company of France. The apparatus of M. Napoli will easily be understood from Fig. 6, which shows the regulator applied to actuate the valve M. Upon the axis of M is the toothed wheel R, engaging V, and moving indifferently in either direction. At each end of the axle carrying V is an electro-magnet, E E^1. The two iron pulleys P P^1 are mounted as shown, turning

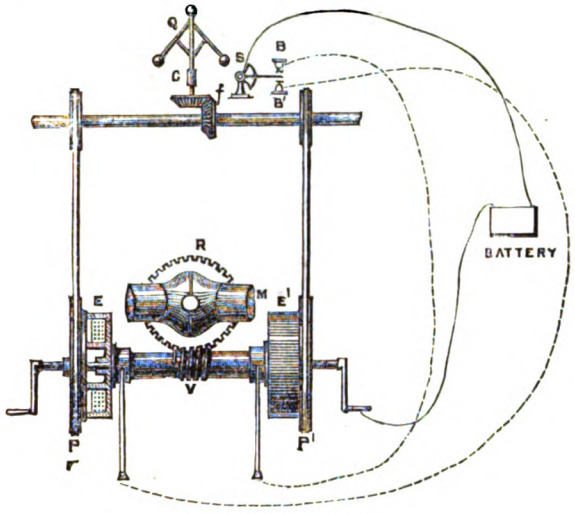

Fig. 6.

inversely and freely on the axle. On sending a current into E or E^1 the iron is attracted, and becomes the armature of the magnet, rotating V in one direction or the other, according to the magnet, through which the current passes, acting through V or R, opening or closing M as may be. The direction of the current is regulated by means of the governor Q, which, according to its velocity, causes a contact to be made by the pointer C with B or B^1. Of course, as soon as contact is broken at B or B^1, the action of the electro-magnet ceases. It is said that the apparatus is very sensitive, and is actuated by a small Leclanché cell.

Napoli's Dynamometer.

The "Compagnie de Chemins de fer de l'Est" shows also a very interesting dynamometer, designed by M. Napoli to explore a magnetic field. The production of electricity in dynamo and magneto-electric machines is due to the motion of a conductor through a magnetic field. In this case the electromotive force is at each instant proportioned to the number of lines of force cut by the conductor during a unit of time. It is of interest, then, to concentrate as much as possible the lines of force, so that the whole be cut by the rotating conductor, and to arrange the armatures in the best manner. The dynamometer exhibited is to be used for investigating this problem. The whole of those parts of the apparatus which determine the magnetic field are mounted in in a cubical box, which may be made to rest on either face upon a bronze slab, which can receive either (1) a vertical motion or (2) two horizontal motions at right angles to each other. A small piece of iron, *m*, too small to influence the magnetic field under investigation, is maintained at a fixed point—Fig. 7. This iron, *m*, is carried by a copper rod, I, fixed to the cross-piece *a b* resting on the brackets *t* t^1, the cross-piece being also attached to the spring R S. The action of R S is limited by the binding screws K K^1. The end R of the spring is connected to a steel band fastened to the sector A B, which works under the action of the lever L and its connections M N as shown. During the movement of the sector the tension of the spring R S varies continuously. If the arrangement be pro-

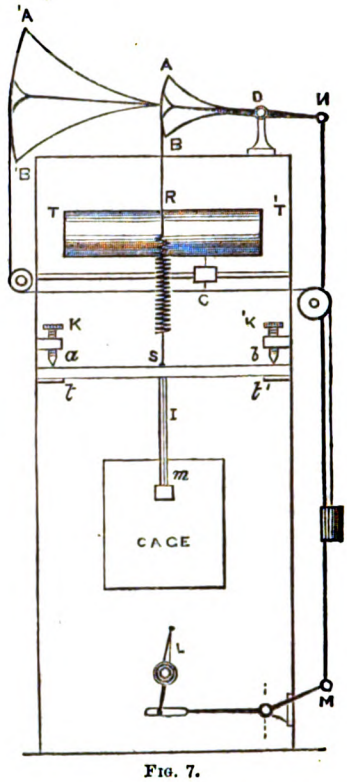

Fig. 7.

perly made, at a particular moment the force exerted in one direction on *a b* is greater than the attractive force exerted on *m* ; *a b* will thus be displaced and make contact with K K^1. Another sector, A^1 B^1, which moves synchronously with

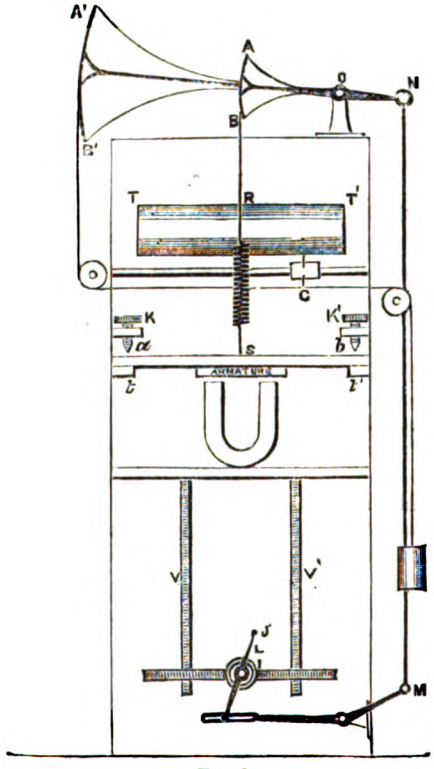

Fig. 8.

A B, influences a runner C which in its movement traverses a cylinder, T T^1, on which a band of paper is wound. When *a b* comes into contact with K and K^1, an electric current passes and causes a pencil carried by C to be with-

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drawn from the paper. Thus the number of displacements of C are proportional to the tension of the spring R S. And it therefore follows that the length of the line traced on the cylinder T T^1 by the pencil attached to C will be proportional to the resultant forces of R S and *m*. To render the chance of error very small, the screws K K^1 can be so regulated as to make the play of *a b* extremely minute. In order to avoid one line being written over another on the cylinder T T^1, a slight angular movement is given to it after each operation.

To explore a given magnetic field it is necessary to divide, in the mind's eye, the box which contains the said field into a large number of small cubes, and to consider the tops of all these cubes. If we can ascertain the amount and direction of the force which is developed at each of these points the problem will be solved. By taking advantage of the three rectangular movements which can be given to the slab carrying the box, we can bring the small piece of soft iron *m* under the influence of each of these points successively. We shall, moreover, be able to measure the resultant of the force exercised on each of these in the fixed direction R S. Give the box a quarter turn and repeat the same operations, and we shall have the resultants in a direction perpendicular to the first. Lastly, begin again by resting the box on another face, not parallel to the two first, and we shall have the resultant in a direction perpendicular to the two first. We shall thus know the resultant of the force which is exercised on each point in three rectangular directions; and we shall know the amount and direction of this force. This apparatus gives at once the law of variation of the attractive force exerted by a magnet, or an electro-magnet, on its armature. This is a very useful law, both for horology and telegraphy, for fixing the forms to be given to relays.

A very simple modification of the apparatus exhibited permits continuous diagrams to be obtained—Fig. 8. The lever L, which influences the movements of the spring, acts, by means of an endless screw, on two screws V and V^1, which are advanced or withdrawn one-tenth of a millimetre at each turn of the lever, and carry the magnet with them. At the same time the cylinder T T^1 receives an angular movement proportional to the recoil of the spring.

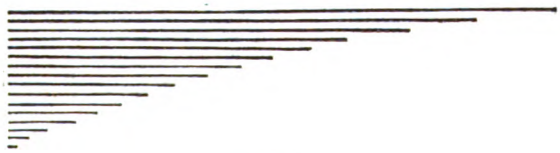
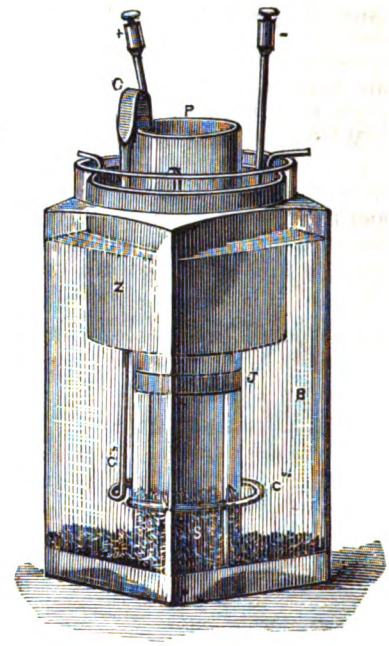


Fig 9.

If, then, the lever L is turned continually, and at the same time the paper band of the cylinder T T^1 is unwound, a diagram will be produced similar to the one shown in Fig. 9. If the extremities of the lines traced by the pencil of the runner C be united, we have a curve graphically showing the exact variation of the attractive force developed on any given armature; the distance will be proportional to the abscissæ and the strength of the ordinates.

GAIFFE'S NEW ARRANGEMENT FOR BATTERIES.

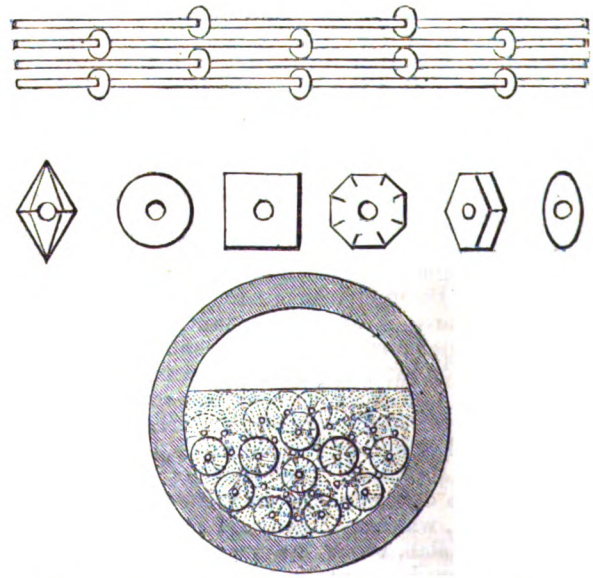
The following arrangement has been adopted with the view of nullifying the action of the zinc on the sulphate of copper when the circuit is open:—The cell is composed of (1) a glass jar, B, to the upper part of which is suspended a zinc plate, Z, as in a Callaud cell; (2) a central jar, P, formed of a porous part, P J, and a non-porous part, J S, which is an ordinary drinking glass; (3) A copper rod, C, contained inside the inner jar, which passes almost to the bottom of the jar B, and is then curved in an annular form, C′ C″. The cell is charged with a concentrated solution of sulphate of zinc and some crystals of sulphate of copper, which are placed at the bottom of the jar S. In dissolving, the sulphate of copper saturates the liquid contained in the part J S, of the central jar, and when this liquid rises above the dark line J, it traverses the porous jar and falls by reason of its density to the bottom of the jar B, out of reach of the action of the zinc. But this change of the sulphate of copper from the one jar to the other takes place very slowly; and the circuit of the battery may be left open for weeks before any deposit of copper will be found on the zinc. When the circuit is closed less internal



resistance being offered between Z and C″ than between Z and C, the sulphate of copper fallen to the bottom of jar B is at once reduced, and the liquid soon regains its purity.

GORE'S SYSTEM OF INSULATION.

Mr. Gore, impressed with the idea that a large quantity of material is wasted for purposes of insulation, has devised a system whereby he obtains insulation without such loss. He separates his wires by perforated insulating discs, as shown



in the illustration. The discs are fixed by machinery, and at such distances that there seems to be no possibility of chance contact. If it is desirable to use the system for underground lines, the wires are laid in a porcelain tube. This tube, after the cable of wires is in position, is filled with insulating material. The inventor proposes to use liquid glass for this purpose, which, solidifying, would

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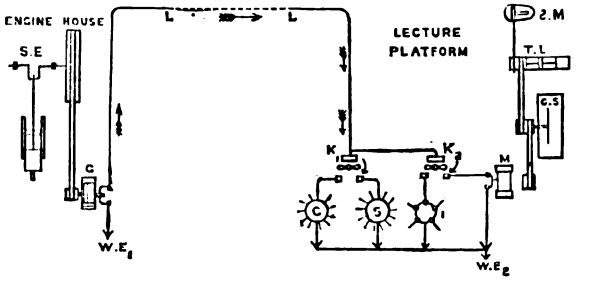
preserve the wires from rust, and give almost perfect insulation. A section of pipe partially filled with wires is shown. The wire used is galvanised iron wire, and to make doubly sure the pipe containing the wires is surrounded by a second pipe, not shown in the drawing, so that in most cases it is supposed that merely insulating with dry sand, or similar materials, would be sufficient to obtain good and economical insulation. We shall watch with some interest the various suggestions that have recently been made to obtain insulation, inasmuch as the tendency of public opinion is towards a system of subterranean instead of aerial wires. It will be seen that this system necessitates only one thickness of insulating material between any two wires.

GREENOCK PHILOSOPHICAL SOCIETY.

At the opening meeting of the twenty-first session of this society, which was held lately, Mr. Andrew Jamieson, C.E., Principal of the College of Science and Arts, Glasgow, read a paper on "Electricity as a Lighting and Power-transmitting Agent." Mr. Jamieson said his subject was one which was engrossing the attention of some of the greatest and most scientific men of the present day, and every possible means was being tried to make electricity applicable not only for lighting our streets and houses, but also for driving machinery in certain well-defined cases. The great improvements that had been made within the last four years justified the belief that its application would soon become general. He explained the principle of magneto-electric induction, first discovered by Faraday, and showed the effects produced by a small magneto-electric machine. He then magnetised an ordinary soft iron poker, by passing a current of electricity through a helix of insulated copper wire surrounding it. Mr. Jamieson then described the principle upon which the machines of Gramme, Siemens, Burgin, and Brush are based, explaining the different details of these machines by aid of large wall diagrams, which he had prepared for the occasion. He said that he was indebted to Mason Brothers, telephone engineers, Glasgow, for erecting the overhead wires, to Messrs. John Walker and Co. and Messrs. John Poynter and Sons for two Siemens dynamo machines,



one of which was fixed in Messrs. John Hastie and Co.'s ironworks and driven by their workshop engine, the other being placed on the platform. By means of these appliances he would be able to have some two and a half horse-power of electricity generated in Messrs. Hastie's works conveyed over the intervening houses by a single bare copper wire, and brought to the lecture room platform, where he would demonstrate its effect in lighting the various lamps and driving the machinery before them. It might interest them if he were to show some of the lamps which he had with him. First he showed a Crompton light, which burned with great brilliancy and steadiness, as well as seven Swan lights in a beautiful rosette, and another in a miner's lantern. The Crompton, he observed, was one which the people of Greenock might well use at their large open spaces and dock quays, as it was specially well adapted for such places, whilst the Swan lamp would be very suitable for their houses and offices. He also showed specimens of Edison's, Maxim's, and Lane-Fox's incandescent lamps, and an ingenious electrical steering apparatus for steering vessels, the design of his friend, Mr. Falconer King, of Edinburgh, which had been practically tried on board a steamer sailing from the Clyde last summer. On the platform there was exhibited a circular saw of fourteen inches in diameter, a turning lathe, and a Wilcox and Gibbs sewing machine, which were all worked at the same time by the electricity generated by the Siemens machine in Messrs. Hastie's works. By this means a plank six inches thick was sawn through with ease, a doll was turned in the lathe, and a piece of cloth sewn by the sewing machine. These, the lecturer said, demonstrated the practicability of using electricity as a power and showed how they could take advantage of any of the surrounding waterfalls, and usefully employ the electricity generated there for purposes of lighting or work in their town. At the conclusion a vote of thanks was unanimously given to Mr. Jamieson for his paper.

The accompanying diagram illustrates the position and connections of the various apparatus used by Mr. Jamieson to explain his lecture, and may be found of interest to students. S E is the steam engine, which was situated in Messrs. John Hastie and Co.'s Iron Works; G is a Siemens generator dynamo-machine driven by the engine S E; W E_1 represents earth, being a bare copper wire (No. 8 B.W.G.) soldered to a lead water pipe; L L is a single bare copper leading wire (No. 8 B.W.G.) taken over the roof of the intervening houses between the engine house and the lecture hall, insulated at the points of support by ordinary porcelain insulators; K_1 and K_2 are two commutator switches for distributing the current to the various lamps and motors; C is a Crompton arc light, and S a Siemens arc light; I is a cluster of Swan lamps; M is the motor, a Siemens dynamo-machine; W E_2 is another earth (lead water pipe); C S is a 14-inch circular saw from Messrs. Hastie's works; T L is a turning lathe from the Greenock Philosophical Society's workshop; S M is a Wilcox and Gibbs sewing machine.

THE ELECTRO-TECHNICAL SOCIETY OF BERLIN.

The first meeting of this flourishing society for the present winter was held on the 25th inst. in the German capital, Dr. Stephan, the Postmaster-General and president of the society, filling the chair. In opening the proceedings, Dr. Stephan spoke of the completion of the underground telegraphic system of Germany, the details of which have recently been given in these columns. Passing to another department, Dr. Stephan said that within the past few months the introduction of telephones had been making rapid progress in the large cities of Germany. Already there were seven large cities fully supplied, and preparations were being rapidly pushed forward in a large number of other towns. He spoke also of the progress of the Electro-Technical Society itself. It was only in its second year, and already numbered 1,568 members. Professor Neesen then read the paper of the evening, "Upon Thunderstorms and Lightning Conductors." The lecturer remarked that our knowledge of thunder or lightning storms and their effects had long been very imperfect, while our means of protection against lightning were still more defective. The researches of the past few years had, however, contributed to throw more light on the subject. There is a wide-spread impression that electrical storms are more frequent in the present day than in the past. This had been shown to be false. In a little treatise "On the Increase of Danger from Lightning, and its Supposed Causes" Herr Holtz had clearly demonstrated that such a notion is entirely devoid of foundation, in fact. It is quite another question whether buildings in the present day are not exposed to greater danger from lightning than in former times. The statistical returns of the different fire insurance offices do, as a matter of fact, exhibit a surprising increase in the number of fires caused by lightning. It has also been ascertained that there is far greater danger of such fires in the case of isolated buildings, such as farmhouses or other structures or dwellings in the country, than in the case of houses in towns. The structures which are most exposed to peril are windmills and churches. The question arises, Why should edifices be more in danger of being fired by lightning at the present day than in earlier times? Herr Holtz, the writer above referred to, attributes the increased peril to the different way in which houses are built, and Professor Neeson agreed with this view. It is more particularly to the much larger use now made of iron that the increased danger is to be attributed. Another cause was the ever increasing disappearance of woods and forests, and the denudation of large tracts of country of all timber. Remarkable differences had been observed between different portions of Germany in regard to the proportion of lightning flashes which produced fire to those which did not. In South Germany the "cold" sheets of lightning were four times as numerous as the "burning" flashes. In North Germany, on the contrary, they were only *half* as numerous. One of the principal causes of this vast difference was to be found in the different kinds of roofing in use. In North Germany, in the case of country houses, the common material was straw or reeds for thatching, while in the south the roofs were more frequently of tiles or slate. It has been shown by the statistics of lightning compiled by Dr. Weber, of Kiel, that a similar connection between cause and effect prevailed in Schleswig-Holstein. Out of eighty-five flashes observed, twenty-five kindled fire. Of the houses struck, twenty-two were thatched with straw or reeds, while the roofs of only the remaining three buildings were of other materials. Dr. Weber was of opinion that the reason for the difference was that in order to cause ignition the lightning spark must in its progress be retarded. Thus when an electric spark is conducted from a Leyden jar into gunpowder, it does not ignite the latter, but only mechanically scatters it. If, however, we insert a piece of wet cord, then, owing to the retardation of the electricity, the gunpowder is fired and explodes. Applying this illustration to the case of thatched roofs, we see that it is owing to the rain wetting the straw or reeds that the passage of the electric fluid is retarded, and so causes the roof to ignite. According to the observations of Holtz it is not only straw or reed thatching, but likewise the metallic appliances fastened to buildings, particularly vanes or weathercocks, that act injuriously. It is a common opinion that tall buildings or high trees are a direct protection against danger from lightning; but this, as Professor Neesen showed by a number of instances collected by Dr. Weber, was a groundless notion. There are cases recorded in which the lightning has been clearly shown to have been conducted by lofty trees to the houses near them. The lecturer then proceeded to say that against all dangers arising from the electric fluid in storms the only real and trustworthy protection is to be found in good lightning conductors. How these appliances are attached to edifices makes a great and essential difference, as they must be brought into connection with any large masses of metal near them. In such cases, particularly with large buildings, a single line of passage leading to the ground was insufficient. The question was also important as to the circumstances under which the electric fluid, while passing along a good conductor, would leap from it to another object. This phenomenon of the electric fluid suddenly leaping from one conductor to another had been frequently observed in the case of telegraph wires. Dr. Stephan promised that the Telegraphic Department should publish the observations that had been, or might be, made on this point. In conclusion Professor Neesen discussed the question of lightning conductors more in detail. There are, he said, still many prejudices prevailing against their use amongst certain classes in Germany. There were two systems in use, that of Gay-Lussac, and that of Melsens. The former had but a few very high rods, and few conductors to the ground; while in Melsens' system every exposed point of the building had its own little pointed rod. Of these two systems, Professor Neesen considered that, owing to the extensive employment of iron in buildings in the present day, the latter was decidedly the better. As regards the material for the conducting rods, Professor Neesen supported the opinion published by the Berlin Academy of Sciences in favour of iron. It had the advantage of being more difficult to melt, as well as being cheaper, and, therefore, less attractive to thievish hands than copper.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All communications to be addressed to 396, Strand, London, W.C.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

We cannot undertake to return drawings or manuscripts, and must, therefore, request Correspondents to keep copies.

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THE OCEAN BED.

We have from time to time directed attention to the importance of a knowledge of the bed of the ocean. Not only is such information of the greatest value to those engaged in the work of laying and repairing submarine cables, but it is also very important to those engaged in the ordinary operations of commerce. Sir James Anderson recently, in a letter to *The Times*, insisted upon a pretty constant use of the "lead," and pointed out that the facilities for easy soundings offered by the use of Sir W. Thomson's improved apparatus left no excuse for neglecting such operations. The constant use of the "lead" would make seamen as familiar with the ocean bed over which they passed as the coachman is of the landmarks past which he drives, so that in the case of the seaman neither darkness nor fog would cause him to lose "touch," so to speak, of his position. Then, again, the increased trustworthiness of charts could not but prove a great boon to the seafarer. It ought to be widely known that the development of oceanic telegraphy has led to a very large number of alterations and corrections in charts; but we believe the Eastern and Eastern Extension Companies, the Telegraph Construction and Maintenance Company, Messrs. Siemens, the Silvertown Company, and others have for some years done more towards surveying the ocean than our own Government. This, it may be said, has been done in the ordinary course of business; but surely it is not the ordinary course of business for private companies to obtain information at a very great expense and give that information gratuitously to the public. And yet this is what has been done in the particular instance to which we refer. The facts gleaned during the necessary operations of these companies have been to a large extent incorporated in the charts issued to seamen, and thus the world is the gainer. What the Telegraph Construction and Maintenance Company has done on the east coast of Africa, the Silvertown Company is going to do on the West Coast of America. The "Retriever," a vessel of 380 tons net, has been chartered for the special work. The vessel has carried a Thomson wire sounding apparatus for the last three years, and has already done some excellent cable and sounding work on the Peruvian and Chilian coasts, under the orders of Mr. E. W. Parsoni, the engineer and manager of the West Coast of America Telegraph Company. The "Retriever" is now to survey the ground over which the Central and South American Telegraph Company's cables are to be laid. This survey is to be carried out under the direction of Mr. E. Parsoni, assisted by Mr. G. Darling, as chemist. It is within the recollection of some of us that a few years ago the Government fitted out a surveying expedition, and the "Challenger" was the vessel selected for the work. The reports of the "Challenger" expedition, interesting as they would be to all engaged in cable work, are incomplete, and the portions published practically unknown to the majority of mankind. A good deal of sharp criticism has been written concerning the manner in which these reports have been made, and it is within the bounds of possibility that when copies have been supplied to the libraries of learned societies in foreign lands the claims of those interested in the subject at home will be considered. We may be told that the papers read before the Royal, the Geographical, and other societies, convey to the practical man most of the information required. This, however, even if we admitted the wide distribution of these papers, we should deny. Suppose, for example, we take a paragraph at random from one of these papers, viz., *Proceedings Royal Society*, No. 170, p. 521. "Down to about 1,500 fathoms we have Pteropod, Heteropod, and surface Gasteropod shells, and the shore forms of Foraminifera are common. Deeper than 1,500 fathoms, Pteropod shells are rare or entirely removed. Pelagic Foraminifera are found at all depths; but occasionally they and the siliceous organisms are quite absent at a depth of little over 2,000 fathoms, and then we have a clay or mud, with many small particles of pumice, scoria, &c. Manganese appears to be intimately associated with some of these bottoms, especially when the *débris* of angitic lavas are present, as at the Sandwich Islands, Canaries, and elsewhere. Off the Desertas, in 670 fathoms, all the dead shells, pieces of Polyzoa, &c., had a slight coating of this substance, and we had indications of the same thing in even less depths. In 1,100 fathoms, off the Canaries, some pieces of shell had rather a thick coating; and in 1,575 fathoms, not far from this place, the dredger brought up a great quantity of a Gorgonoia ascis deeply embedded in or coated with this black oxide of manganese."

The time will come when such generalities as these will be looked upon like the elementary geological lessons given to young children, and the advanced student will have to know as much about the sea-bed as the advanced geologic student does about the land surface. The reports of the "Challenger" contain a good deal of this special and detailed information, and should, we maintain, be placed within the reach of every young aspirant to a position of responsibility on board ship. As we have said, the Silvertown Company understands the necessity of knowing not only the depth but the kind of sea bottom on which a cable is to rest, and they send out an expert chemist with the expedition. The vessel will be supplied with a steam sounding machine, with twenty thousand fathoms of steel sounding wire, and the necessary sinkers, thermometers, water bottles, &c., for obtaining specimens of the bottom and samples of the water at various depths. The soundings are to be taken at an average distance of four miles apart in deep water, but of course with far greater frequency at the landing places. The total number of soundings is expected to reach about 900. When we consider the land surface of the world to be far less extensive than the water surface, and also consider our ignorance as to a large portion of this land surface, some faint idea will be obtained as to our ignorance of the ocean bed. Any such series of soundings as these, which are to be commenced in January next, warrants more than a mere passing glance, and we trust to be able to obtain at a future time some detailed information as to the results of this survey.

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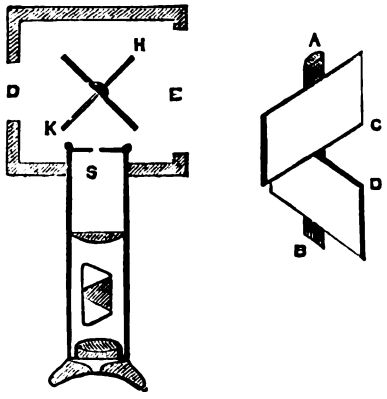
CORRESPONDENCE.

ON THE MEASUREMENT OF THE ELECTRIC LIGHT.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: As the chief difficulty in doing the above consists in comparing the intensity of two different colours, I beg to submit the following to the notice of your readers. It is well known that the whiter colour of the arc is due to the greater intensity of the ultra green rays which it contains compared to those in a candle's light; therefore, if we can absorb, cut off, or disregard those rays, we shall be able to compare the brightness of two like colours.

One way that has been adopted to effect this is to compare the differently-coloured shadows of a rod through red and other coloured glasses—generally green, the red being tolerably monochromatic, therefore giving two similarly-coloured shadows, but the other glasses are very far from being so. The result is, the two shadows are never of the same colour; moreover, the results obtained cannot be those desired by the practical public, who do not wish to know how many red or green candles the red or green rays of the arc are equal to, they want to know the relative illuminating powers of the two lights, generally considered. As the extreme blue and violet rays are practically absent in the candle's light, it is manifestly impossible to compare those rays in the arc to those which do not exist in candle light. In order to obtain any real comparison we must leave out those rays. It is true that we will not thus obtain the absolute illuminating power of the arc, but only the relative power for similar colours, but



this is all we really want. To make a general and complete comparison it is only necessary to examine the two lights simultaneously by the spectroscope, the upper part of the slit receiving light from a mat white plane illuminated by one light, and the lower part that from another plane lighted with the other source of light. As all eyes are not equally sensitive to rays above and below that colour corresponding to the B line of the solar spectrum, and as the spectra of candle and electric light begin to differ from one another above the line E in the green, I find it necessary to confine the comparison between these limits, and sometimes solely to the yellow green part just above the sodium D lines. The greater the dispersive power used, the easier and more accurate will be the comparison. A two-prism spectroscope is amply sufficient and very suitable, although a direct vision one will do very well, besides being more portable and handy.

It is obvious that this spectroscopic method of examining two differently coloured lights allows a very general comparison to be taken, and shows at one glance what would have required a number of observations through a number of monochromatic glasses.

The diagram shows a convenient form of photometer, in which the above principles are applied. A B is a wooden rod two inches long, on which are fixed two white cardboard planes at right angles to each other, each plane being 1 by $\frac{3}{4}$ inch. The edges C and D are cut very straight and square and pressed closely together. If these planes be put between two equal lights, and the line of vision be at right angles to that of the lights, they will look like one large plane with but a very small line across its centre. The rod A B is placed upright in a box, two inches each way and blackened inside, as represented in the transverse section D S E, where H K represents the planes. D and E are the apertures through which the lights to be compared, shine on their planes. S is the hole in which the collimator tube of the spectroscope is inserted; or when the lights are like in colour, through which to look at the planes. The slit must be placed as close as possible to the centre line of the planes so as to get as much light as possible.

By using Professor Ayrton's plan of placing a concave lens between the brighter light and its plane, by inserting a neutral-tinted glass, whose absorptive power is known, or by altering the angles of incidence with which the lights strike the planes, the measurements may be carried on in a very much smaller space than without these methods of reducing the brighter light. The concave lens may have a focal length of 1 inch, and be mounted in tubes so as to slide out to about 12 inches or more if possible, their diameter being $\frac{3}{4}$ inch. The aperture for the candle light had better be 1 inch. I think the following is the formula to be used with the concave lens of a principal focal length = F.

$$\text{The Brighter light} = \left(\frac{(ab - a^2 + Fb)^2}{F^2 c^2} + C\right) \text{candles},$$

where a, b, and c are the respective distances of the lens, arc, and candle, C is the constant for the absorptive power of the lens; its value I find—for one I have of $\frac{3}{4}$ inch diameter and 2 inches focal length—is 14 per cent. The value of C, as well as that of the neutral glass when it is used, can easily be determined with a Bunsen photometer and 2 equal lights.

Another method for comparing a yellow and white light is to absorb those rays in the latter which do not exist in the former. If we look at the planes H and K without a spectroscope the candle's plane will appear very orange in colour compared to the arc's, but we can make the arc's plane have the same colour by painting it a full orange (the exact shade being determined by experiment) in the white light, so as to match the orange shade of the candle's plane. The respective distances of the two lights can now be adjusted so as to give the same intensity of light, and therefore the relative illuminating powers of the two can be determined. By this means it is very easy to compare day and candle-light.

A modification of Maxwell's colour box, with an upright cylindrical lens instead of the usual spherical one, makes another interesting method of comparing two lights which differ in colour. By putting the two white planes, above described in front of the large aperture of the colour box, and then sliding a screen over the violet end of that aperture until the upper and lower parts of the lens appear to have the same tone of colour, we can then alter the distances of the lights so as to get the same intensity, and thereby the relative power of them.

S. Hampstead. ARTHUR WRIGHT.

HISTORY OF THE TELEGRAPH.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Having not only read your interesting *résumé* of telegraphic development which appeared in *The Electrician* of the 8th inst., but also the letter signed "F. M. K." in your issue of Oct. 15, regarding "Who is Right," and being down at Greenock the other day, giving a lecture on electricity before the Philosophical Society there, I made enquiries regarding the initials "C. M." Through the kindness of the librarian at the Watt Institution I am enabled to send you the following information, which I hope may prove as interesting to your readers as it most certainly was to me.—Yours, &c., ANDREW JAMIESON.

College of Science and Arts, Glasgow, Oct. 31, 1881.

CHARLES MORRISON, A NATIVE OF GREENOCK, WHO FIRST SUGGESTED THE PRACTICAL APPLICATION OF ELECTRICITY TO THE TRANSMISSION OF MESSAGES.

Although the first steps in the invention of the telegraph were taken in France by M. Le Monnier, and in England by Sir W. Watson, about the year 1747, yet the idea of its

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practical application to the transmission of messages was undoubtedly first suggested by an anonymous correspondent of the *Scots Magazine*, dated Renfrew, Feb. 1, 1753, signed "C. M.," and entitled "An Expeditious Method of conveying Intelligence." After a good deal of correspondence on the subject, Sir David Brewster gave up all hope of discovering the name of the inventor, and it was not till 1859 that he had the great pleasure of solving the mystery, in the following manner:—He "received from Mr. Loudon, of Port-Glasgow, a letter, dated 31st Oct., 1859, stating that while reading the article in the *North British Review* his attention was arrested by the letter of 'C. M.,' and having mentioned the fact to Mr. Forman, a friend then living with him, he told him he could solve the mystery regarding these initials. Mr. Forman recollects distinctly of having read a letter, dated 1750, and addressed by his grandfather, a farmer near Stirling, to Miss Margaret Winsgate, residing at Craigengilt, near Denny (to whom he was subsequently married), referring to a gentleman in Renfrew of the name of Charles Morrison, who transmitted messages along wires by means of electricity, and who was a native of Greenock, and bred a a surgeon. Mr. Forman also states that he was connected with the tobacco trade of Glasgow—that he was regarded by the people in Renfrew as a sort of wizard, and that he was obliged, or found it convenient, to leave Renfrew and settle in Virginia, where he died. Mr. Forman also recollects of reading a letter in the handwriting of Charles Morrison, addressed to Mr. Forman, his grandfather, and dated 25th September, 1752, giving an account of his experiments, and stating that he had sent an account of them to Sir Hans Sloane, the President of the Royal Society of London, who had encouraged him to perfect his experiments, and to whom he had promised to publish an account of what he had done. In this letter Mr. Morrison stated that as he was likely to be ridiculed by many of his acquaintances, he would publish his paper in the *Scots Magazine* only with his initials."—*The Home Life of Sir David Brewster*: Edinburgh, 1869.

The following is a copy of the paper referred to:—

AN EXPEDITIOUS METHOD OF CONVEYING INTELLIGENCE BY MEANS OF ELECTRICITY.

Renfrew, Feb. 1, 1753.

To the author of the *Scots Magazine*.

Sir,—It is well known to all who are conversant with electrical experiments, that the electric power may be propagated along a small wire, from one place to another, without being sensibly abated by the length of its progress. Let, then, a set of wires, equal in number to the letters of the alphabet, be extended horizontally between two given places parallel to one another, and each of them about an inch distant from that next to it. At every twenty yards end let them be fixed in glass or jeweller's cement to some firm body, both to prevent them from touching the earth or any other non-electric, and from breaking by their own gravity. Let the electric gun-barrel be placed at right angles with the extremities of the wires, and about an inch below them. Also let the wires be fixed in a solid piece of glass, at six inches from the end; and let that part of them which reaches from the glass to the machine have sufficient spring and stiffness to recover its situation after having been brought in contact with the barrel. Close by the supporting glass let a ball be suspended from every wire; and about a sixth or an eighth of an inch below the balls place the letters of the alphabet, marked on bits of paper, or any other substance that may be light enough to rise to the electrified ball; and at the same time let it be so contrived, that each of them may re-assume its proper place when dropt. All things constructed as above, and the minute previously fixed, I begin the conversation with my distant friend in this manner. Having set the electrical machine a-going as in ordinary experiments, suppose I am to pronounce the word *Sir*; with a piece of glass or any other *electric per se*, I strike the wire S, so as to bring it in contact with the barrel, then *i*, then *r*, all in the same way; and my correspondent, almost in the same instant, observes these several characters rise in order to the electrified balls at his end of the wires. Thus I spell away as long as I think fit; and my correspondent, for the sake of memory, writes the characters as they rise, and may join and read them afterwards as often as he inclines. Upon a signal given, or from choice, I stop the machine; and taking up the pen in my turn, I write down whatever my friend at the other strikes out.

If anybody should think this way tiresome, let him, instead of the balls, suspend a range of bells from the roof, equal in number to the letters of the alphabet; gradually decreasing in size from the bell A to Z; and from the horizontal wires, let there be another set reaching to the several bells; one, vizt., from the horizontal wire B to the bell B, &c. Then let him who begins the discourse bring the wires in contact with the barrel, as before; and the electrical spark, breaking on bells of different size, will inform his correspondent by the sound what wires have been touched. And thus, by some practice, they may come to understand the language of the chimes in whole words, without being put to the trouble of noting down every letter.

The same thing may be otherwise effected. Let the balls be suspended over the characters as before, but instead of bringing the ends af the horizontal wires in contact with the barrel let a second set reach from the electrified cake, so as to be in contact with the horizontal ones; and let it be so contrived, at the same time, that any of them may be removed from its corresponding horizontal by the slightest touch, and may bring itself again into contact when left at liberty. This may be done by the help of a small spring and slider, or twenty other methods, which the least ingenuity will discover. In this way the characters will always adhere to the balls, excepting when any one of the secondaries is removed from contact with its horizontal; and then the letter at the other end of the horizontal will immediately drop from its ball. But I mention this only by way of variety.

Some may, perhaps, think that although the electric fire has not been observed to diminish sensibly in its progress through any length of wire that has been tried hitherto; yet as that has never exceeded some thirty or forty yards, it may be reasonably supposed that in a greater length it would be remarkably diminished, and probably would be entirely drained off in a few miles by the surrounding air. To prevent the objection, and save longer argument, lay over the wires from one end to the other with a thin coat of jeweller's cement. This may be done for a trifle of additional expence; and as it is an *electric per se*, will effectually secure any part of the fire from mixing with the atmosphere.—I am, &c.,

C. M.

NEW USE FOR THE ELECTRIC EEL.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: The phenomenon described in the enclosed paragraph seems to me barely credible. Can you or any of your readers kindly throw light upon it. It is from the *Churchman*, a paper of New York, dated Saturday, July 9, 1881.—Yours, &c.,

C. J. Blacker.

121, St. George's-road, S.W., Nov. 7, 1881.

"Mr. Morton Wright, by a series of remarkable experiments, has discovered the secret of the source of the electricity in the torpedo vulgaris and the gymnotus electricus, or electric eel. If his experiments are to be relied on, he has demonstrated that heat is the secret power. By the use of a thick felt, made of wool, salt, and metallic oxides, placed alternately between discs made of the skin and intestines of the fish, he produced a strong current of electricity, and one of these batteries, three inches in diameter and ten inches high, ran one of Edison's electric lamps of twenty candle-power for twelve days, when the carbon gave out. A similar battery, sixteen inches in diameter and twelve inches in height, runs four arc lights. If Mr. Morton's experiments are corroborated, we shall thus have a new source of supply for electrical power, and at comparatively small cost."

CONTACT THEORY OF THE VOLTAIC CELL.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In the latter part of Mr. FitzGerald's letter, p. 375,

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he assumes (as I think correctly) that the difference of potential exhibited by two conductors in contact (I presume in an oxydyzing or other medium) is a function of their respective heats of combination with oxygen. Then, why state that, in the case under consideration, "it is due to the contact between the metals hydrogen and copper?"

The definition:—"Any two conductors exhibit an electroscopic difference when brought into contact," needs to make it complete the addition, "provided the surface of one of them is undergoing a more energetic chemical combination with the surrounding medium than that of the other."

So far as I can discover no experimenter has yet measured the potential-difference of two clean metals in contact under conditions that entirely precluded the possibility of chemical action at the surface of one or both, and until that has been done, I submit that we have no ground for maintaining that the *contact* is the cause of their potential difference. I admit that they will not show a difference of potential unless they are in contact, neither will an engine draw a train unless it be coupled to it; but neither the motion of the engine and train, nor the potential-difference of the metals, has its *origin* in the coupling between them.

When a copper-water-zinc cell becomes "polarised," would it not be more correct to say that a decrease of E.M.F. results because the deposit of hydrogen on the copper has a chemical attraction for the oxygen of the liquid greater than that of copper?

J. Brown.

Belfast.

ANSWER TO CORRESPONDENT.

Illuminating Power of Incandescent Lamps.—We would refer Mr. H. H. P. Powles to our note on p. 347 of Vol. VII., where he will find an answer to his question.

THE LATE DR. ROBERT MALLET, F.R.S., C.E.

It is with sincere regret that we have to record the death, on Saturday, the 5th instant, of Robert Mallet, at his residence, Enmore, the Grove, Clapham-road. His death removes one more from the list of those who from 1830 to 1855, or 1860, were the foremost labourers in the physical, geological, and engineering sciences. He was born in June, 1810, and was the only son of John Mallet, manufacturer, of Dublin, and twice high sheriff of that city. At a very early age he (Robert) showed great aptitude for the study of chemistry, and as a boy was provided with a small room for a laboratory, supplied with materials and apparatus as he required them. He went to the Bective House School until he was sixteen years of age, then made his first Continental tour, and on his return entered Trinity College, being at the same time under the tuition of a private tutor. When twenty years of age he took his B.A. degree, went another tour through the Continent, and on his return commenced study of practical engineering work in his father's works, and by visiting works in various places in England. He married in 1831, was elected Member of the Royal Irish Academy in 1832, was a frequent contributor to the *Transactions* of this body from that time, and to the *Reports* of the British Association he was a frequent contributor from 1825. His first paper in the *Reports* of that Association is "On an Economic Application of Electro-Magnetic Forces to Manufacturing Purposes," the chief thing described being the employment of automatically magnetised and demagnetised soft iron magnets for the separation of brass and copper from iron and steel borings and plugs. Another paper in this direction was published in 1843 *(Phil. Mag.)* "On the Application of the Electrotype Process in Conducting Organic Analysis." Some exceedingly interesting experiments on the magnetic condition of railway rails, and the currents of electricity developed by the passages of locomotives and trains, and the effects of magnetism and electricity on the corrosion of rails are given in his very full *Report* to the British Association on an experimental enquiry conducted at its command on railway bar corrosion. He minutely studied the action of feeble currents of electricity on metals in presence of solvents, and wrote a good deal on the part played by them. He did not, however, make a special study of electricity. His name will probably be best known by his labours in the study of earthquake phenomena and vulcanicity. He was the first to apply exact methods of observation and estimation to these phenomena, seismology being, in fact, his own term for a branch of science on which he threw more light by systematic experimental observation than any other worker. His writings on vulcanicity and experiments in relation thereto are also illustrations of the way in which he always brought the severest tests to any hypothesis, and they will always stand forth as the first application of thermodynamics to physical geology. He paid a great deal of attention to gunnery and ordnance and his book, the reprint of nearly a volume of the *Transactions* of the Royal Irish Academy, on the physical conditions involved in the construction of artillery, contains the first investigation into the principles and method of constructing ordnance in superimposed rings with initial tension. Guns are now built up in this manner for every government, and the monster mortars constructed by Mallet for our Government in 1855-6 were the first scientific embodiment of the principle. In 1842 Mallet was elected Member of the Institute of Civil Engineers, was at one time President of the Institute of Civil Engineers, Ireland, and of the Royal Geological Society of Dublin, Corresponding Member of the Royal Philosophical Society of Göttingen, Ph.D. of the University of Giessen, Fellow, and at one time Member of Council of the Royal Society, LL.D. of Trinity College, Dublin, and Fellow of the Geological Society, by which he was awarded the Wollaston Gold Medal in 1878.

The Royal Society catalogue contains the titles of no less than 74 scientific papers down to the year 1873, since which date five or six original papers, throwing new light on certain questions in physical geology have appeared. He had been for several years almost wholly blind, and had dropped out of the active world. He leaves two daughters and three sons, Dr. J. W. Mallet, F.R.S., R. T. Mallet, C.E., Chief Ex. Eng., India, and F. R. Mallet, F.G.S., H.M.'s General Survey, India.

ON GROVE'S, PLANTE'S, AND FAURE'S SECONDARY BATTERIES.

BY PROF. W. GRYLLS ADAMS, F.R.S.

At the opening meeting of the King's College Scientific Society Prof. Adams read a paper on this interesting subject. The first part of the paper was principally historical, showing that the effects on which the action of secondary batteries depend have been known since the beginning of the century. Volta discovered his battery in 1800, and in 1801 Gautherot observed the action usually ascribed to polarisation. In 1803 Ritter, of Jena, also observed the phenomenon, and devised a battery for making use of the currents. Volta and Marianini, and afterwards Becquerel, investigated the action. Grotthus, in 1805, and Sir Humphrey Davey, in 1806, attempted to explain the phenomena, as did De la Rive in 1825. In 1833 Faraday attacked the subject, and set the whole theory of electrical decomposition on a firm basis in his four series of papers communicated to the Royal Society betwen June, 1833, and March, 1834. Prof. Adams described the work of Faraday and the laws of electrolysis deduced from this work. "The chemical power of a current of electricity is in direct proportion to the absolute quantity of electricity which passes." Faraday powerfully reasons as to the identity of Voltic and machine electricities. He says:—

"One grain of water, acidulated to facilitate conduction, will require an electric current to be continued for three minutes and three quarters of time to effect its decomposition, which current must be powerful enough to retain a platina wire $\frac{1}{10\frac{1}{4}}$ of an inch in thickness, red-hot, in the air during the whole time; and if interrupted anywhere by charcoal points, will produce a very brilliant and constant star of light. If attention be paid to the instantaneous discharge of electricity of tension, as illustrated in the beautiful experiments of Mr. Wheatstone, and to what I have said elsewhere on the relation of common and voltaic electricity, it will not be too much to say that this necessary quantity of electricity is equal to a very powerful flash of lightning. Yet we have it under perfect command; can evolve, direct, and employ it at pleasure; and when it has performed its full work

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of electrolyzation, it has only separated the elements of a single grain of water."

Subsequently Professor Adams said: He (Faraday) may almost be said to have discovered a secondary battery similar to that of M. Planté or M. Faure. When using acetate of lead for his solution he finds that the results at both electrodes are peroxide of lead appearing at the positive and lead itself at the negative pole.

In 1843 Grove made an important addition to the problem when he invented his gas battery, which Professor Adams discussed at some length, afterwards referring to the units adopted for the various measurements required in relation to this subject. The latter part of the paper was devoted to the consideration of the question of storage of electrical energy.

We may store up electrical energy of very high potential in a Leyden jar or condenser, and make use of it at intervals, instead of taking it continuously from an electrical machine. We cannot raise the potential of the charge in the Leyden jar any higher than the potential of the machine from which it is charged. We may as well expect heat to flow from a cold body to a hot one and make it hotter, or think that we can get water of its own accord to flow up a hill into a reservoir at the top. In connection with this question of storage of energy it may help us to trace the analogy between difference of potential with regard to electricity and difference of lead with regard to the force of gravity. The difference of potential giving rise to electromotive force between two points which are united by a conductor causes a current of electricity from a point of higher to a point of lower potential, just as a difference of level giving rise to pressure between two points in a water channel causes a flow of water from the higher to the lower level. The electromotive force corresponds to pressure, and the resistance of the circuit corresponds to the hindrances to the flow; the current corresponds to the quantity of water flowing per unit of time. Thus, of two paths from one level to another, the current will be most rapid along the steepest channel, and in the same way with the same electromotive force, the greatest current will be along the line of least resistance.

The electricity supplied by the electrical machine will be like a very small stream supplied by a pump at a very great height, and discharging itself by a small pipe at a very much lower level, so that it is capable of exerting very great pressure, but when allowed to run it can do very little work because the quantity is small. The Leyden jar is like the reservoir into which the water is pumped at a high level, and when the size of this reservoir is increased we know how difficult it is to prevent leakage from the very great pressure exerted by the water, and how dangerous the bursting and discharge from such a reservoir may be to those on the lower level who may happen to be on the path of the discharge.

On the other hand, the ordinary Grove battery which gives us electricity in abundant quantity, but of small difference of potential, is like a means of obtaining, when required, an ample supply of water as from a large reservoir not far above the level when it is wanted to be used, and so giving an abundant supply at low pressure. Had this mode of supplying electricity continued to be the principal one, we should, probably, not have so much need, and should not hear so much of secondary batteries; for, instead of burning up the zinc in the Grove battery to charge up the secondary battery like a large reservoir to-day, in order that the stored-up electricity may be used to-morrow, it would, probably, be better not to charge the Grove battery until to-morrow, and then use it directly to do the work required.

The development of Faraday's discovery that the motion of a coil of wire in front of the poles of a magnet or in a magnetic field gives rise to an electric current in the wire, has shown us that the burning of zinc or other materials in batteries such as Grove's or Daniell's is a very expensive way of producing an electric current, and that it is far more economical to obtain electric currents by employing the best mechanical means we have to produce rotation of the coil of wire in the magnetic field. The different magneto and dynamo-electric machines (and they abound) are but the results of attempts to find the best form of coil, the best kind and best form of magnets, the best proportion of resistances, and the most suitable arrangements for the special work in each case which is required to be done. The dynamo electric machine, driven by a steam engine or by a gas engine, is very satisfactory as a mode of producing electricity, and both the electromotive force and the current increase with the rate of rotation of the coil. This mode of producing electricity is like raising water to any level that may be required in each particular case; but the electricity must be used at once whilst the steam engine, or the gas engine, is in action. This may be very inconvenient, and hence the necessity for something like a reservoir to store up the electricity. The labours of Faraday have shown us the relation between the quantity of electricity and the weights of the chemical elements decomposed by it in an electrolyte, and that these chemical elements may unite again to reproduce the same quantity of electricity. The object, then, to attain by means of secondary batteries is to find some substance which can be decomposed into two others which will remain apart, even when joined by a liquid conductor, until a complete electric circuit is made. Then these two substances should be at considerable difference of potential, so as to give a strong electric current in uniting again to form the substance from which they were decomposed.

In 1859, M. Planté, taking advantage of the great affinity of peroxide of lead for hydrogen, made use of this substance to increase the effects of secondary batteries, and so was led to make use of lead electrodes instead of platinum, which had been the metal hitherto employed. He found that better results could be obtained with one cell with lead electrodes, than with two cells with platinum electrodes. So from this battery, plates of lead with a finely divided layer of lead upon them are taken as electrodes. A current from 2 Grove cells is sent through the cell containing them, immersed in dilute sulphuric acid of strength about 1 to 10. The current is sent for a quarter of an hour in one direction, then the cell is fully discharged, the current from the primary battery is then sent through it for a quarter of an hour in the opposite direction, after which the cell is again discharged. In this way it is charged over and over again in opposite directions for longer and longer periods, care being taken each time that the secondary cell is fully discharged. Then the battery is again charged, but when it is capable of giving out the charges slowly enough for the purpose for which it is to be used, then the successive chargings should no longer be given in opposite directions, but always in the same direction. We may say that after the battery is formed, it should always be charged in the same direction.

In charging by sending a primary current through the cell, peroxide of lead is formed at the positive pole, and the negative pole becomes somewhat crystallised. When detached, the peroxide of lead forms the positive pole of the secondary battery, and the battery will remain in action until the two plates return to the same state, the positive pole being reduced from the peroxide to the oxide of lead, and the negative pole being transformed from lead to the oxide of lead.

M. Planté has especially aimed, by means of his battery, to convert electricity obtained from an ordinary battery into electricity of high tension, to do in a smaller degree what is done by means of the Ruhmkorff induction coil. By means of two cells of Grove or Bunsen he can charge a great number of cells, a dozen or more, arranged for quantity, *i.e.*, with all their positive poles together and all their negative poles together, and when they are charged by arranging them in series, *i.e.*, with the positive pole of one joined to the negative pole of the next, he can get great electromotive force, and at the same time obtain electricity in great quantity.

By his battery of 800 cells, which he has set up in Paris, and by the aid of his rheostatic machine, which I have not time to describe, he can imitate lightning discharges and remarkable luminous effects, somewhat analogous to the brilliant effects of the aurora borealis.

The electro-motive force of a single cell of Plauté's battery is about 2½ volts, or 2½ times that of a Daniell's cell, *i.e.*, about 1½ times Grove's cell, hence, two cells of Grove will charge a Plauté cell. The quantity of electricity that may be collected will depend on the amount of chemical action, *i.e.*, on the extent of the surface of the plates, and on the way in which that action has gone on. When the action has gone on rapidly the battery will not be so good as when the action is slow. The Planté battery, as usually formed, discharges itself too rapidly for many purposes for which electric accumulators are now required, and hence other secondary batteries or modifications of the Planté battery are now making their appearance. The cells may be charged by a dynamo-machine, and may also be used to drive a dynamo-machine like an electro-magnetic engine or motor, driving it in the same direction as it was driven when used as a generator to charge the cells.

The Planté cell will also heat a platinum wire of considerable diameter, for although the electromotive force is only 2½ volts, yet the quantity is sufficient to make a platinum wire 3-10ths mm. in diameter and 4cm. in length to glow for half an hour.

The secondary battery may be made use of in telegraphy to do away with the residual magnetism in an electro-magnet, so as to enable it to work more quickly after a current has been sent through it. The secondary cell should be attached with its positive pole to the line, and its negative pole to the key, the other end of the line or the earth being also attached to the key, so as to form a complete circuit when the key is up; the sending battery consisting of two or more cells of Grove, or at least three Daniell's cells, should have its negative

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pole attached to the negative pole of the secondary cell and its positive pole to the key, so as to form a complete circuit with the line and secondary cell when the key is down. When contact is made with the sending battery by putting down the signalling key, the circuit is sent through the secondary cell into the line, thus giving a slight additional charge to the secondary cell, and bringing the electro-magnet into action; on breaking contact by releasing the key, the secondary cell, being still connected to the line, sends a reverse current into the line, and weakens or may even be strong enough to reverse the magnetism of the electro-magnet. If we work a Morse instrument first, with the sending battery alone, and afterwards with the secondary cell in the circuit, we find that there is a very great increase in the rate of signalling when the secondary cell is used. The secondary current increases as the battery current increases, and, being in the reverse direction, instantly weakens the magnetism of the electro-magnet, so that signals may be sent as fast as the operator can make and break contact. Planté's secondary battery has been employed to work an electric break on railway trains. With two Grove's cells or three Daniell's cells and a Planté cell arranged as above described the Planté cell is continually being charged, or is kept from getting weaker, except when the key is depressed, which completes the electric circuit by which the break is set in action. The quantity of electricity stored up in six Planté's cells suffices with such an arrangement, to prevent the cells from becoming exhausted, to work the breaks on a dozen railway carriages, and to last for a fortnight. To renew the charge in the Planté cell a battery of six Daniell's cells may conveniently be employed. It is important that the charging should be carried on with great regularity, so that the layer of peroxide of lead may be regularly laid on, otherwise it will not adhere well to the lead electrodes.

Several forms of secondary batteries have appeared quite recently, now that the demand has arisen for a reservoir in which to store up the electricity produced by the dynamo-electric machine, and the secondary action or polarization of batteries is no longer regarded as something to be avoided as much as possible, but is eagerly sought after. Professors Houston and E. Thomson, of Philadelphia, have tried electrodes of copper in sulphate of zinc. When a current is sent through the cell, zinc is deposited on the negative pole, and sulphate of copper formed around the positvie pole, the plates being laid horizontally, so that the sulphate of copper so formed, and the sulphate of zinc shall be presented by their relative weights from mixing too readily.

This we may call a gravity secondary battery, and its electromotive force will be nearly the same as that of one Daniell's cell or 1 volt. M. d'Arsonval modifies this battery by using one electrode of lead and another of zinc in a solution of sulphate of zinc. The lead forming the positive electrode becomes coated, as in the Planté's cell, with peroxide of lead.

Several modifications of Planté's cell have been suggested, which have for their object the reduction of the weight of lead employed; such are the batteries of M. de Pezzer and of M. de Meritens, who fold their laminœ of lead in layers like the leaves of a book, so as to get as much surface as possible for a given weight of lead. M. de Pezzer also finds that the relative size of the positive and negative plates modifies the results obtained, a greater quantity of electricity is stored up when the negative electrode is double the size of the positive electrode than when the two electrodes are of the same size.

Other modifications, in which the negative pole is either paladium in dilute sulphuric acid or thin sheet iron in a solution of sulphate of ammonia, have been suggested and employed by M. Rousse, these substances being chosen on account of their great power of absorption of hydrogen. These can hardly be called secondary batteries, since two metals are employed as electrodes.

The method of charging secondary batteries may sometimes be conveniently made use of to renew ordinary batteries which have become used up. Thus, a Leclanché cell which has been in use for a long time, and become weak, may be recharged again by connecting up the positive pole of a stronger battery with the positive pole of the Leclanché battery, and allowing the current to pass through it for a considerable time. The secondary battery to which most attention has been drawn during the last few months is the Faure battery, in which M. Faure does not form the cells by electrolysis, but coats the lead plates with a film of red lead or minium, enclosing or protecting the red lead coating with a layer of felt. His cells are of large size, and each is therefore capable of storing up a considerable quantity of electrical energy. The chemical action is similar to the action in a Planté cell, but the resistance is higher, and when in use the battery takes longer to discharge itself, so that for electric lighting and for many purposes for which a store of electricity is required it seems to be better adapted than the Planté cell. It has been said, and the statement has been confirmed by Sir Wm. Thomson, that a "Faure accumulator, weighing 75 kilogrammes (165lb.), can store, and give out again, energy to the extent of an hour's work of one horse-power," or two million foot-pounds. At first these cells were made cylindrical, and the Faure Accumulator Company have kindly lent me a box of four such cells in action, similar to the celebrated box of electrical energy or condensed lightning, so graphically described in *The Times* of May 16 last, which was carried from Paris to Glasgow for examination and measurement by Sir W. Thomson. They have also lent me one of their latest forms, in which the plates are flat, and placed vertibally in the box. It has been ascertained by Sir W. Thomson that Faure's accumulators, amounting in weight to three-quarters of a ton, will continue to work for six hours from one charge at the uniform rate of one horse-power, and that probably 90 per cent. of the energy spent in charging will be transformed into useful work. Very few comparative trials have been made of the Planté and the Faure batteries, but from those which have been made by M. Achard, it appears that, as might be expected, they are equal in electromotive force, that the Planté cell is of smaller resistance than the Faure cell, and, consequently, will heat a longer piece of platinum wire, and do its work three times as rapidly. The Planté cell kept a plantinum wire 3-10ths mm. in diameter and 5 or 6 cm. long red hot for half an hour, and the Faure cell kept the same wire red hot for and hour and a half. We may readily see by a few experiments that the Faure's battery has collected a great quantity of electrical energy, for one box of it will cause a platinum wire of considerable length, and 1mm. in diameter to glow, and one cell is sufficient to drive a small dynamo-electric machine as a motor, or to drive a small electric engine, and the three or four cells are sufficient to cause a small Swan's incandescent lamp of small resistance to give out a very pleasant light of about two candles. There are many applications which may be made of secondary batteries. Six Planté cells have been found sufficient to drive a tricycle with 160 kilogrammes, or about 300lb. upon it, at a rate of ten miles an hour, or to drive a boat containing three persons.

(1). These secondary batteries may be used to carry a supply of electricity, where it is wanted.

(2). They may accumulate supplies from a dynamo machine, and store energy up for electric lighting or for motive power.

(3). They may serve as regulators for the electric current, when as in electric lighting it is liable to fluctuations, either from the irregularity of the driving engine, or from the change of resistance in the electric arc or in the electric circuit. When so used, they would supply and keep up the light, even though the engine were suddenly to stop, or any accident to happen other than the cutting of the connecting wires.

The Faure's Accumulator has been employed to light a railway train from London to Brighton by means of incandescent lamps, to work an electric motor so as to drive a circular saw or other mechanical tools, and it has been employed with very satisfactory results in driving a tramway in the streets of Paris, and in the Siemens electric railway between the Electrical Exhibition and the Place de la Concorde. The results already attained seem to shew that there is no other secondary battery which can compare with this for storing up and keeping for a long time a supply of electric energy, and for using it slowly when in action

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Nov. 9.		Business Done Week Ending Nov. 9. Highest.	Lowest.
Anglo-American	52½,	53½	54½	52½
Do. Preferred	82½,	83½	84½	82½
Do. Deferred	23½,	24	24½	23½
Brazil Submarine	11½,	⅜	11⅝	11½
Cuba	9½,	⅜	—	—
Do. Preference	16,	17	—	—
Direct Spanish	5,	¼	—	—
Do. Preference	14½,	15½	—	—
Direct United States Cable	10¾,	11¼	11⅜	11½
Eastern Telegraph	10,	¼	10½	10½
Do. 6 per Cent. Preference	12½,	13½	13½	12⅝
Do. 5 per Cent. Debentures, 1899	105,	108	—	—
Eastern Extension	11,	¼	11¼	11¼
German Union	10¼,	11	—	—
Globe Telegraph and Trust Company.	6½,	¾	6 11-16	6½
Do. Preference	12½,	¾	12¾	12½
Great Northern	12,	¼	—	—
Indo-European	27½,	28½	—	—
Mediterranean Extension	2½,	3	—	—
Do. Preference	9½,	10	—	—
Reuter's	12,	12½	12½	12½
Submarine	290,	300	294	293
West India and Panama	1½,	2	1⅞	1⅞
Do. 1st Preference	7½,	8	7⅞	7⅞
Western Brazilian	6¾,	7¼	7 3-16	6¾
West. Union 7 per Cent. 1st Mortgage	123,	128	—	—
Do. 6 per Cent. Sterling Bonds	**104,**	**107**	**106¼**	**106¼**

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RECENT INVENTIONS.

ABSTRACTS OF SPECIFICATIONS.

918. Producing Audible Signals on Railways by Electricity. *E. Tyer.*—3*rd March*, 1881. 8*d*.

The inventor places a gong, having its hammer worked by the armature of an electro-magnet, at or in advance of the distant signal, the coil of the electro-magnet being acted on by battery currents, which are intermitted by means of a rotating commutator caused to revolve by clockwork. An electrical contact apparatus is arranged at the side of a rail some distance in advance of the gong, with which it is in electrical connection, so that on a train passing this point it effects contact by the depression of a trigger or deflection of the rail. When contact is thus momentarily made by the train, a polarised contact at the gong is made to close the circuit of an electro-magnet at the clockwork which releases a detent, and the clockwork at once starts the intermittent commutator, so that the gong is sounded. When the clockwork has been in motion long enough—say, from half to three-quarters of a minute—it, by its own movement, replaces the detent and stops itself, leaving the electrical connections in place for another start; the replacing of the detent also causes a momentary reversal of current, which moves the polarised contact of the gong and breaks the circuit, which remains broken until the passage of another train. The apparatus is also made to depend on the position of the signal lever in the signal box.

922. Galvanising Iron, *J. Elmore.*—3*rd March*, 1881. 4*d*.

This consists in the employment of powerful dynamo-electric machines and solutions of zinc salts to produce the galvanising result.

1094. Improved System of Automatic Rapid Telegraphy, &c., *B. J. B. Mills.*—14*th March*, 1881.—(*A communication from W. A. Leggo.*) 8*d*.

The object of this invention is to furnish a system of automatic rapid telegraph transmission, in which one machine may be used both for the preparation for transmission and for the transmission of messages. The method followed is to cause the ordinary manipulations of a key to be recorded in insulating and conducting spaces on a suitable surface, and then to utilise this record to automatically control the transmitting circuit. The apparatus is fitted with gearing, by means of which its speed can be regulated according to whether it is desired to transmit or receive messages. The dots and dashes, or insulating and conducting spaces, are made on specially prepared paper by means of a pen, made to hold a supply of the printing fluid, and to open and shut as required. The inventor also makes use of a specially designed telegraph key, the movable contact point of which can be made to move faster than the rate of motion of the actuating power. The details of the apparatus are too lengthy for description here. The specification is accompanied by descriptive drawings.

1107. Improvements in Electrical Bath Apparatus, *W. R. Lake.*—14*th March*, 1881.—(*A communication from B. Barda.*) 6*d*.

This invention relates to an improved electrical bath apparatus suitable for public establishments or hydrotherapeutic institutions. It consists of a reservoir constructed of wood, and provided with the usual means for letting water in and out. At the front end of the reservoir are fixed seven copper terminals. The two lower are connected by wires with the electric generator. The five upper ones are connected to two terminals, which are themselves in connection with carbon poles let into the interior surface of the bath, and corresponding with the principal parts of the body which it is required to electrify. A device is also described for electrifying the whole of the body if desired. In order that the bather may turn the current on or off at will a commutator is provided.

1206. Electrical Apparatus for Automatically Recording Time Signals, &c., *R. Harper.*—19*th March*, 1881. 6*d*.

The inventor uses a paper dial in connection with and driven by an ordinary clock, this dial being marked off into days, hours, minutes, &c., according as the clock is an eight-day, or only a daily one. At a particular point in the dial is fixed an electro-magnet, and at this point the time marked on the dial by a pointer provided is always the same as that indicated by the clock, that is, the dial is driven in unison with the clock, but the pointer is fixed. The effect of a current being sent into the electro-magnet, by completing the circuit through a contact piece, is to cause the magnet to act on its armature, which is a centred lever, one end forming the armature, and the other being free to press against a spring push furnished with a sharp point, which, when the other end of the lever is attracted, is pushed by the other through a slot in the dial so as to puncture the paper. On the current ceasing the lever returns to its normal position, the spring push doing the same. The apparatus can be used as a watchman's detector, registering the exact times he has been at given points of his round and given the required signals. The signal is given by simply pressing down ordinary contact keys placed at the required points, and so completing the circuit. Some slight alteration in the mechanism of the push point is, however, necessary to adapt the apparatus for this purpose, owing to the different points from which the signals are sent.

1235. Electric Lighting, *G. A. Tabourin.*—21*st March*, 1881. 6*d*.

The inventor makes use of a supply of compressed air, obtained at a central station, and conducted thence through pipes to the standards of the various electric lamps. In the base of each of these standards is placed a magneto-electric machine, and a motor for working the same, the machine being connected by wires running up the interior of the lamp-post with the carbons of the electric lamp in the usual way. The compressed air is first passed into a reservoir furnished with an indicator and an outlet pipe; it is then let into the main pipe conducting to the lamps by turning a tap. There are separate branch pipes to each lamp furnished with another tap at each lamp, which is accessible from the pavement or elsewhere, and this must be opened before the air can get to the motor. There is also a spring valve which will not admit the air until a certain pressure has been attained capable of moving the motors at a determined speed. The air after being used in the motors escapes into the base of the lamp-post, and serves to cool the apparatus.

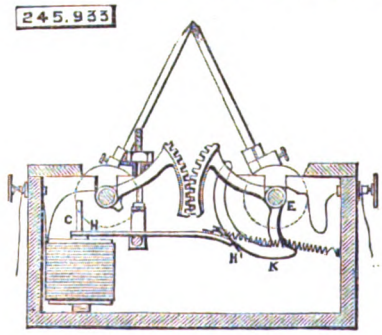
1236. Electric Lamps, Candles, Candle-holders, and Apparatus Connected Therewith, *J. A. Berly.*—21*st March*, 1881. 8*d*.

The improvements relate to details and combinations. The movable parallel carbons in this system are brought into contact only at the time of lighting, the oscillating electro-magnets and armatures being hinged by strips of flexible material instead of by pins, axles, &c.; the switching from candle to candle being accomplished by fusible plugs or pneumatically.

245,933. Apparatus for Electric Lighting, *Joseph Best, Montreal, Quebec, Canada.*—*Filed March 9th*, 1881.

Claim.—(1) In an apparatus for electrical lighting, the carbons and horizontal rock-shafts provided with the geared sectors, in combination with a friction-sector mounted on one of said rock-shafts, and with means for actuating it, substantially as shown and described. (2) The combination of the electro-magnet, the armature lever

245.933



H, provided with flexible insulating piece H¹, the support M¹, and shaft, E, provided with friction-sector, K, all substantially as described and for the purpose set forth. (3) In combination, the electro-magnet C, armature lever H, provided with the insulated piece H¹, and with a retractile spring support M¹, having means for its adjustment, as described, and the shaft E, provided with a friction-sector K.

245,972. Mercury Terminal for Telegraph Cables, *William R. Patterson, Chicago, Ill., assignor to the Western Electric Manufacturing Company, same place.*—*Filed April 1st*, 1881.

Claim.—(1) The terminal consisting of a U-shaped pipe in combination with mercury, through which one or more conductors are run, substantially as and for the purpose specified. (2) The terminal consisting of U-shaped pipe and mercury

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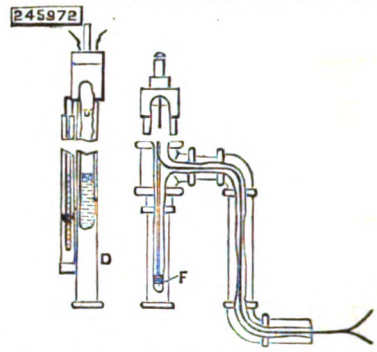
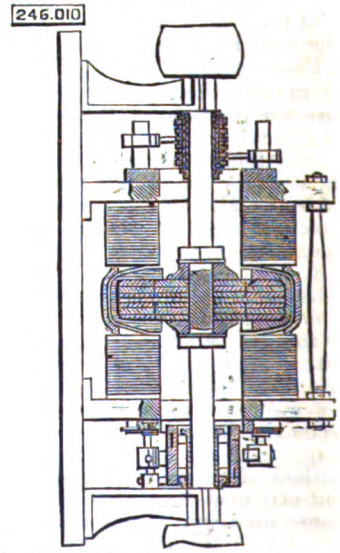


in said pipe, in combination with a rubber plug, one or more electric conductors and hollow pins, one for each conductor, and binding-posts, one for each hollow pin. (3) The terminal consisting of pipe D, wires E, and mercury F, in combination with a cable.

246,010. Magneto-electric Machine, *Otto Heikel, Jersey City, N.J., assignor to the National Electric Light and Power Company, New York, N.Y.*—*Filed November 14th*, 1878.—*Patented in France September 15th*, 1877.

Claim.—(1) In a magneto-electric machine, one or more ranges of armature helices connected in one or more closed circuits within the machine, and circuit connections passing from the respective helices to an electric light or other device to be operated by electricity, and returning to the machine through one or more common conductors, substantially as set forth. (2) The armature or electro-magnet cores in a magneto-electric machine, projecting at each side of a disc or central support, in combination with the helix-wires wound across the central support and at the sides of the cores and around the ends, substantially as set forth. (3) The combination, in a magneto-electric machine, of a range of cores and helices connected together in a closed cir-

246.010



cuit, insulated rings upon the revolving shaft, connections from the rings to the respective helices, a circuit spring, and separate circuit connections to each ring, return circuit connections, a commutator for the return circuit connections, and a field-of-force magnet in the circuit from the commutator, substantially as set forth. (4) In an electric system adapted to numerous lights or other devices operated by electricity, a dynamo-electric generator having an armature with two or more helices or sections, collecting springs, and circuit connections, substantially as specified, whereby the current passes in both directions from the springs, through the working devices, and then through the helices of the field-magnets, substantially as specified.

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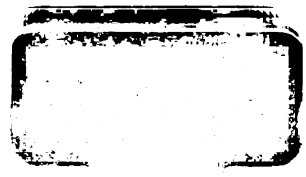

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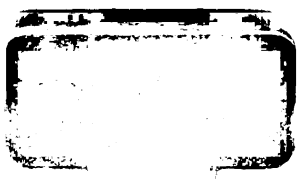

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